RAILROAD GAZETTE

FRIDAY, NOVEMBER 2.

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# Contributions.

## Station Distant Signals.

BOSTON, Oct. 22, 1888.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your issue of Oct. 9 contains the most complete account of the Mud Run disaster which I have yet seen. Your editorial seems to me pertinent and its conclusions sound. But, while indorsing all you say about the block system, there are other points bearing on the subject, not mentioned by you, which may with great propriety be considered in connection with this event.

Ignorance of the law cannot be pleaded in a court of justice as a bar to the punishment of violations thereof, nor does it in any way diminish the gravity of the offense—indeed, it may even aggravate it in some cases—unless it can be shown that the guilty party has diligently used all the means in his power to ascertain what he ought to do, but without avail. Public sentiment will usually sustain the view that a man has no right to do what may put himself or others in jeopardy, without first finding out whether the proposed action may safely be taken. We carry this reasoning into the physical world, and demand that men who use its forces shall know the laws which govern them, and that they to whom the transportation of human lives is intrusted shall know how to guard them safely. May we not judge the management of a business by this principle, and apply the same reasoning to the Mud Run accident?

The Lehigh Valley road is located in a central and thickly settled region. It has abundant resources and skilled and intelligent officials, to whom the most modern ideas and appliances for increasing the safety of railroad operation are, or may be, well known; all the wisdom which the large and varied experience of other railroads has acquired, is accessible to it: it also has abundant opportunity to make experiments of its own. May we not, then, fairly hold the management of this road responsible for the consequences if they have neglected to use in a place like that, where this accident occurred, any device of reasonable cost, which may prevent such a catastrophe? There are such devices; they have been in use for many years, on railroads doing a large freight and passenger business, and it has been shown beyond a reasonable doubt that when officials do not (as you say of the block system) "expect impossible things," they add very materially to the safety of trains. I refer to automatic signals. Here was a place and a set of circumstances where, if anywhere in the world, intelligent prudence would dictate their use. A station hidden from view of approaching trains until they are close upon it; a signal which is relied upon to hold back trains from coming to [going beyond] the station, located, not where it ought to be, at a distance sufficient to admit of stopping a fast train before reaching the station, should the signal show danger, but at or near the end of the station platform (as a matter of fact this signal not used at all on this occasion); trainmen, some of whom, at least, appear to have been unfamiliar with the duties they were selected to do, and not in the physical condition in which they should have been to do the best work of which they were capable, and running under orders not so explicit as to leave no room for doubt or misinterpretation. Is it a matter for surprise that an accident resulted? Yet it might have been very easily prevented. Less than $500 would have provided an automatic signal at a safe distance from the station, and less than $100 would maintain it for a year. How many such might have been put up and kept in order for the sum this accident will cost, to say nothing of the fearful loss of life! Have the officials of this road any ground on which to stand in explanation of the reason why they have not adopted something of the kind? These are not new and untried devices. A large number of roads have them in use, and some have equipped their whole line. They are not intended as a substitute for watchfulness and vigilance, but they are a valuable addition to these safeguards in the operation of a railroad. The great expense of the block system is often urged as a reason for its not being more generally adopted, and this argument is doubtless often sound; but no road running many passenger (or even freight) trains can afford to take the risk of such an accident as this, when the road may be made so much safer at so small an expense. It is easy to see now that the trainmen, or the operator, or some other person or persons, did not take proper precautions against accident; but while attempting to place the responsibility where it belongs, we should, I think, not lose sight of the fact that the failure to provide automatic protection for this station was a remote cause of the disaster. It is most fervently to be wished that the lesson may not go unheeded.

GEO. W. BLODGETT.

## Merchants' Excursions.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It may not be generally known there is every probability of some concerted action after election by the different trades in this city, looking toward a public request by the merchants to the trunk line railroads for a more extended issue of excursion or half-rate round-trip tickets.

On the part of the merchants the object is avowedly to encourage dealers in the small towns and cities in visiting the metropolis. Many of these now depend entirely upon neighboring small jobbers or upon traveling salesmen for their needs, and come personally to New York but rarely. Such a state of things is not to the advantage of wholesaler or retailer. The New York jobber or manufacturer who spends time and money in getting up novelties and in keeping full lines of goods requires a certain culture on the part of the buyer for appreciation and profit. A certain amount of ambition and goaheadativeness is necessary before retailers will keep up with the improvements of the metropolitan trade. The stay-at-home retailer often loses this ambition. He must at times, like everybody else, get out of his old rut before he becomes the apostle of advancement in his own neighborhood. So a large amount of direct trade, as well as incentive for further improvements, is dependent upon the freest use of passenger trains.

An objection may be noted here. Such a movement would probably be opposed by the jobbing houses of the interior, but such opposition would be based upon a misconception of the results of such tickets. It is, of course, intended that these retail merchants should buy more at the seaboard than before, but it does not follow that the interior wholesaler would lose his present trade. The case would be something like the gas companies when the electric light was introduced. The former's fears of losses were not realized, because the brighter electric lights in streets and large buildings accustomed the people to brighter light and more consumption of gas at home. So in the proposed half-fare tickets, it is not probable that the near-by jobber would lose any trade in the aggregate, especially when all experience shows that a large amount of the retailer's purchases will be made at home in any event, from the advantages of neighborhood.

The advantages to the railroads are equally clear if the sale of such cheap tickets could be generally confined to those who would not pay the regular fare. A big if, but not an insurmountable obstacle. There seems no doubt that not enough attention has been paid to this matter of cheap travel by our passenger men. The cost of running a passenger train, including every expense except dividends and interest, will, on most good roads, figure out about 75 cents a mile; while it is also probable that the passenger coaches on the average train are not more than half full. Approximately such trains do not contain more than 40@50 passengers on the average, who pay perhaps $1 to $1.25 per mile. If we can add 25 passengers to certain trains at, say, 1 cent per mile each, and if we also assume that five of these are travelers who would have paid full fare on other trains (a large number) we still have 15 passengers whose fares are adding a profit of 10 cents or more per mile. Again, assuming that this takes place only on one-third of the passenger trains, we have a very respectable increase, indeed, in passenger earnings. Of course, all this is pure assumption, and is worthless except as showing from whence possible earnings may be had.

But the man who said "Beware of averages" was right. Such a question as excursion tickets must be largely a question of filling up certain trains. The limited on the Pennsylvania or New York Central do not need such tickets, but there must be slower trains on our trunk lines which now accommodate only local travel, and to which additional New York passengers would be a clear profit even at half the usual fare. It is the business of the progaessive general passenger agent to find the meeting point between slow trains and reduced fare, so that half-filled coaches would become filled, or that additional coaches may be added to a short train without increase of transportation expenses.

Mr. J. Francis Lee, whose long study of this problem entitles his opinions to great weight, suggests, in a letter to me, that such tickets might be issued at reduced rates on certificate from any reputable New York merchant. Something of the kind might be useful in starting the matter, and to help in confining the excursion rates to tradesmen as distinguished from pleasure travelers, in which case the confinement to special trains would not be so necessary.

It is much to be hoped that even the suggession of such wishes on the part of our merchants would call railroad attention, particularly, to this too long neglected subject of cheap travel. Mr. Henry Monett, whose untimely death we all deplore, was a firm believer in excursion fares, and when upon the West Shore demonstrated their value in adding to the net revenue and in stimulating travel. Upon our older roads the problem is more complicated, but the possible increase in net receipts is worthy of the most careful study.

JUDEX.

## Relations of Sections of Rails and Wheels.

The committee of the American Society of Civil Engineers appointed to consider the subject of the relation to each other of wheel and rail sections, has made a preliminary report saying that "in view of the importance of the question raised it seems undesirable to present a final report until the information which they have collected and the conclusions which seem to be indicated have been submitted for discussion, with the probable result of bringing out further information bearing on the matter. They therefore submit the following preliminary or progress report, postponing to a later date the preparation of a final report giving conclusions."

The members of the committee are Messrs. H. Stanley Goodwin, A. M. Wellington, Samuel Rea, George S. Morison, Thomas Rodd, James Archbald and S. M. Felton, Jr.

The committee states its understanding of the question submitted to it to be in substance this: Is it preferable that the sections of rail and wheel should stand to each other in such relation that the fillet of the flange is to a larger radius than the corner of the rail, so that the rail and wheel can only come in contact on the top or at a single point on the corner; or is it desirable that the radii of the flange-fillet and rail corner should be the same, as also the radii of the inside half of the rail-top and the corresponding part of the wheel-tread, so that the two shall be normally in contact with each other (whenever the flange approximates to the wheel at all) from about the middle line of the crown of the rail to the point where the curves of the flange reverse.

The claims made for either design are summed up as follows:

Regarding the first it is claimed:

*First.* That it is the customary and most common form, and has the burden of proof in its favor, being now almost universal.

*Second.* That it is the most practically convenient and attainable form, since it does not require the radii of either fillet or rail corner to be always the same, whereas the conditions of the second are only attainable by universal agreement to make both rails and wheel always of the same radii.

*Third.* That it is the form of least wear, since on tangents and on the inside rail of curves there is a purely rolling contact on top, and on curves an almost purely rolling contact on the corner of the rail, whereas in the other design there is rubbing flange friction, both on curves and tangents, which produces an excessive wear from the beginning of the life of the rail.

*Fourth.* That it is the safer form, in that the flange will not so readily mount the rail.

*Fifth.* That the form of the rail is not as a matter of fact a cause for sharp flanges to any appreciable extent.

*Sixth.* That even if it were, the loss by sharp flanges is a small one, if indeed there be any.

On behalf of the second design it is claimed:

*First.* That the first offers too little bearing surface, which it is desirable to increase.

*Second.* That the first is a cause for sharp flanges, which is removed by making the fillet and rail corner exactly fit each other.

*Third.* That the loss from sharp flanges is so serious as to demand a remedy.

*Fourth.* That no extra wear or extra danger of derailment will result from this form to outweigh its alleged advantages.

The committee has collected statistics never before brought together relative to the wear of wheels, and we reproduce here certain tables condensed by the committee from more extended tables given in an appendix to the report. The first table shows the percentage of wheels removed for sharp flanges. Concerning this table the committee says:

"The relative percentage of sharp flanged wheels needs to be considered in connection with statistics of comparative mileage, and it is also to be remembered and allowed for that there is much irregularity in classification. This is especially conspicuous in steel-tired wheels. Thus, the Boston & Albany and the Lake Shore & Michigan Southern report no sharp flanges whatever among steel-tired wheels. On the other hand, the Chicago, Burlington & Quincy reports 47 to 50 per cent., although the mileage of these sharp-flanged wheels is higher than any other.

"The total per cent. of sharp flanges reported, out of wheels removed for all causes, may be said to range from 2 to 12 per cent. in passenger service, and from 3 to 20 per cent. in freight and engine service."

Concerning the data furnished by the C., B. & Q., Mr. G. W. Rhodes, Superintendent of Motive Power, says:

"We account for this [the large percentage of steel-tired wheels] as owing to the fact that there are many defects in cast-iron wheels, such as shelled out, seams, chipped rim, worn hollow away from flange, etc., which do not occur with steel-tired wheels. Further, the wheels ruined by sliding are very much less with steel-tired wheels than with cast iron. Many more steel-tired wheels, therefore, will remain in service constantly subject to flange wear than with cast iron. Moreover, our steel-tired wheels are used mostly under heavy equipment fitted with 6-wheel trucks. It has been found that the middle wheel of the 6-wheel trucks, notwithstanding the fact that it has no brake shoes to it, wears much more rapidly than either of the other two pair of wheels, and after it has made some thousand miles will almost always be the smallest wheel. I think I am safe in saying it always gives out on account of flange wear and has to be turned down in order to preserve a safe flange and not on account of any wear on the tread.

"Mr. W. A. Scott, until recently Assistant Superintendent Motive Power, Chicago & Northwestern, has made some

very interesting investigations on this matter, and lately has been running some of his 6-wheel trucks without any flange on the middle pair, and I believe with perfectly satisfactory results. Some modification has to be made in the amount of journal-box play, I believe."

Mr. W. A. Scott, Superintendent Madison Division Chicago & Northwestern says:

"My investigation developed the fact that with a long wheel base (9 to 10 ft.), 6-wheel truck, the centre-wheel flanges were cut sharp more rapidly than end wheels, and as steel tires are expensive, we devised a journal box which made the use of centre flangeless wheels absolutely safe, and then economized as follows: When end wheels of truck had worn flanges sharp, and they had been turned off until next turning would leave the tire too thin (less than 1⅛ in.), we turned off flange entirely, thus leaving face of wheel flat, and probably 1¼ or 1⅜ in. thick, and would get a heavy mileage out of this tire located in centre; in fact, as much or more than could be obtained from it with flanges, because when flanges were worn sharp it was necessary to reduce tread thickness from ⅛ to ⅜ in. to secure new flange. It was frequently the case that we could not keep the flanges on a tire and get our 200,000 miles out of same, when by making it flat, when useless for further flange mileage, we could get that much more mileage from same tire, and I think even more, but we have not yet used them long enough to ascertain statistically just how much. My impression is that where 6-wheel trucks are used, one-third maintaining cost can be saved by using a flangeless centre wheel, the end wheels (where steel tires ones are used) furnishing enough tire mileage that would otherwise be scrapped to keep them going."

Mr. F. D. Adams, Esq., General Master Car-Builder of the Boston & Albany, in transmiting data says:

"You will notice that in passenger service no wheel was reported with sharp flange, which indicates, first, that trucks are kept square and in good ordinary condition: and second, that the cast-iron wheel for heavy passenger service will not last long enough, with reasonable care as to exactness in fitting, etc., to wear at the flange sufficient to be condemned for that cause.

"The report of wheels with cut flanges removed from freight service is interesting as showing, in the first place, in connection with other facts presented, the lighter service, as indicated by the proportion of worn flat and slid flat wheels in comparison with the wheels in passenger service; second, that it is possible that the trucks generally in freight service are not adjusted as perfectly as those in passenger, producing a tendency to run to the flange."

TABLE NO. 1.

*Summary of the percentage of sharp-flanged wheels in the total removed on various railroads.*

| Road. | Year. | Per cent. sharp flange wheels. Pass'gr. | Freight. |
|---|---|---|---|
| Boston & Albany | 1884 | None. | 2.97 |
| Lake Shore & M. S. | 1886 | 12.2 | No record. |
| " " (steel-tired wheels) | 1886 | None. | |
| Chicago, Burlington & Quincy | 1885 | 6.4 | 21.5 |
| " " " | 1886 | 10.8 | 20.4 |
| Chicago, Burlington & Quincy (steel-tired wheels) | 1885 | 47.3 | |
| Chicago, Burlington & Quincy (steel-tired wheels) | 1886 | 50.4 | |
| New York, Lake Erie & Western | 1884 | | 5.8 |
| Pennsylvania | 1883 | 4.45 | |
| Pennsylvania Company | 1885-86 | 2.75* | 5.0* |
| Lehigh Valley | 1886 | | 8.8 |

* Estimated, by taking one-fourth of the per cent. of worn-out wheels only, which is about the ratio of the Pennsylvania returns, which give both percentages.

The committee next presents tables showing the *mileage* made by wheels before removal for various causes. Concerning these tables it is said:

"Your committee find it clearly indicated from all the data which they have collected, and in part append to this report, that the average mileage life of wheels removed for sharp flanges is very decidedly above the average life of all wheels, and is even, with one partial exception, the highest among the various causes for removal of wheels worn out by legitimate wear only. * * * The most valuable and decisive evidence as to relative mileage life are the returns of the Pennsylvania Railroad, shown in Table No. 3 and others, since they cover a long period of time (1878-87, ten years) and a large number of wheels, during which time a rigid, minute an uniformd system of classification has obtained. The main part of this record covers only wheels which have failed by wear from legitimate causes, excluding all "slid flat" wheels (which covers from 50 to 60 per cent. of all removals under the rigid Pennsylvania inspection), as also all wheels removed for any cause fit for refitting or freight (20 to 25 per cent. of all removals), and also wheels removed as cracked or broken (less than 1 per cent. of the total). The average mileage of these excluded wheels is, of course, vastly lower than those which are included, which fail from wear."

"It will be seen that the average mileage of wheels with 'worn flange' is very markedly above the average of other wheels which fail from wear, and is even appreciably higher than the average of the two select classes of choice wheels which fail from 'old age' only, *i. e.*, those which show no other sign of defect up to their date of removal than that the tread is too deeply worn (although evenly worn all around) to permit of longer service. This class of wheels constitute only a very small percentage of the total drawn rom service (2½ to 3 per cent).

TABLE NO. 3.

*Showing in detail the average mileage of wheels removed as worn out, for each leading cause of removal. Pennsylvania Railroad, 1878-86, inclusive. Wheels removed as cracked, broken or flat from sliding excluded.*

1 = 1,000 miles.

BAGGAGE, EXPRESS AND POSTAL CARS.

| | Shelled out. | Comby..... | Seams..... | Worn flat... | Wornflange. | Hollow at flange..... | Hollow from flange ..... |
|---|---|---|---|---|---|---|---|
| 1878.... | 88.64 | 73.20 | 88.70 | 77.13 | 83.05 | 74.05 | 91.13 |
| 1879.... | 64.24 | 47.59 | 75.80 | 80.97 | 90.28 | 81.09 | 95.43 |
| 1880.... | 74.65 | 53.59 | 69.35 | 86.75 | 85.51 | 79.78 | 93.32 |
| 1881.... | 68.51 | 46.89 | 31.69 | 60.69 | 76.17 | 95.31 | 80.99 |
| 1882.... | 63.98 | 61.01 | 48.70 | 66.13 | 74.84 | 70.42 | 71.35 |
| 1883.... | 63.19 | 64.17 | 51.70 | 72.07 | 77.70 | 68.53 | 70.80 |
| 1884.... | 65.59 | 68.22 | 68.57 | 62.53 | 78.06 | 58.85 | 75.43 |
| 1885 .. | 76.12 | 71.72 | 67.86 | 73.73 | 73.27 | 79.90 | 82.85 |
| 1886.... | 76.73 | 72.64 | 81.59 | 77.98 | 75.37 | 72.06 | 75.01 |
| Av..... | 71.29 | 62.12 | 64.88 | 73.11 | 78.72 | 75.55 | 81.81 |
| 1887.... | 75.48 | 70.37 | 88.97 | 78.37 | 75.39 | 59.87 | 70.87 |

PASSENGER, COMBINATION AND EMIGRANT CARS.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1878... | 65.87 | 50.91 | 52.82 | 64.60 | 72.18 | 71.22 | 82.20 |
| 1879.... | 61.29 | 46.63 | 87.39 | 69.25 | 79.85 | 77.32 | 81.38 |
| 1880.... | 60.62 | 53.31 | 52.61 | 75.96 | 76.97 | 82.23 | 79.67 |
| 1881.... | 59.02 | 44.61 | 23.20 | 57.14 | 62.51 | 76.02 | 71.00 |
| 1882.... | 51.90 | 54.12 | 37.87 | 57.78 | 69.32 | 64.59 | 68.37 |
| 1883.... | 45.67 | 54.36 | 44.56 | 52.24 | 67.72 | 49.90 | 58.43 |
| 1884.... | 44.45 | 60.11 | 57.33 | 58.58 | 60.33 | 51.27 | 55.15 |
| 1885.... | 50.49 | 58.75 | 56.72 | 56.28 | 56.70 | 54.77 | 57.29 |
| 1886.... | 55.39 | 61.74 | 56.88 | 59.96 | 55.53 | 46.94 | 53.57 |
| Av..... | 54.98 | 53.84 | 52.15 | 61.31 | 66.79 | 63.81 | 67.45 |
| 1887.... | 58.24 | 60.92 | 62.92 | 56.51 | 60.92 | 37.52 | 50.50 |

"The following table, No. 4, shows the percentage of the various causes of removal among *worn out* wheels only, from which it will be seen that the worn flanges are now 37 per cent. of such wheels, and the worn treads, including 'worn flat,' 13 per cent. The steady increase in number of sharp flanges is notable."

TABLE NO. 4.

*Percentage of various defects in wheels removed as worn out (excluding "slid flat" and "cracked and broken" wheels) from passenger, combination, emigrant, baggage, express and postal cars, Pennsylvania Railroad.*

| Causes of Removal. (Worn out wheels only.) | Per cent. of each. 1878-83. Six years. | 1884-86. Three years. | 1887. One year. | Av'ge mileage passenger, combination and emigrant. 1878-86. |
|---|---|---|---|---|
| Shelled out | 29.83 | 17.96 | 13.15 | 54,980 |
| Comby | 7.48 | 33.88 | 36.09 | 53,840 |
| Seams | 5.28 | 1.92 | 0.89 | 52,150 |
| Worn flat | 10.36 | 3.90 | 2.26 | 61,310 |
| Worn flange | 26.63 | 29.87 | 36.72 | 66,790 |
| Hollow in tread at flange. | 4.84 | 2.73 | 1.87 | 63,810 |
| Hollow from flange | 11.90 | 9.08 | 8.42 | 67,450 |
| Miscellaneous | 3.68 | 0.66 | 0.60 | |
| Total (worn out only) | 100.00 | 100.00 | 100.00 | |

Note.—The round-cornered rail (⅝-in. radius) was made standard on the Pennsylvania in 1884, and in 1884 a change of fillet radius was made from ¾ to ⅝-in.

Statistics collected from other roads confirm the figures from the Pennsylvania as to the relatively high mileage of wheels removed for worn flanges.

Another interesting table is No. 5, of which the committee says:

"We abstract in Table No. 5 the percentages for each year of sharp-flanged wheels (in the worn-out wheels only) on the Pennsylvania Railroad, which shows still more clearly that the percentage of sharp flanged wheels has been increasing since the round-cornered standard rail-sections of 1884 and 1885 were adopted, although that section was adopted with the express purpose of decreasing flange wear."

TABLE NO. 5.

*Percentages of worn-out wheels only (excluding cracked and broken and slid flat wheels) removed on the Pennsylvania Railroad, 1878 to 1887, for worn or hollow flanges. Altoona cast wheels of substantially same composition and quality throughout the period covered.*

| Class of service. | 1878. | 1879. | 1880. | 1881. | 1882. | 1883. | Average. |
|---|---|---|---|---|---|---|---|
| Baggage, express and postal | 29.20 | 24.14 | 35.19 | 30.98 | 16.28 | 17.23 | 25.50 |
| Passenger, combined and emigrant | 28.57 | 25.45 | 27.84 | 34.03 | 27.95 | 22.08 | 27.75 |

| Class of service. | 1884. | 1885. | 1886. | 1887. | Average. |
|---|---|---|---|---|---|
| Baggage, express and postal | 23.74 | 31.67 | 39.65 | 39.76 | 33.70 |
| Passenger, combin'd and emigrant | 22.32 | 28.05 | 33.79 | 33.09 | 29.46 |

"In view of all the preceding, your committee see no escape from the conclusion that in spite of the less bearing surface, the less material to wear away to condemn, and the closer inspection, wheels which are wearing sharp at flange make, if anything, a larger mileage than any other class of wheels, and certainly show no appreciably less mileage under normal conditions. This rather surprising conclusion, which was unexpected to every member of your committee, necessarily implies that the rate of abrasion of metal from wheels which are wearing sharp at flange must be materially less in pounds per thousand miles than in wheels which are wearing hollow in tread, because there is a smaller amount of metal to wear away to have the wheels unserviceable."

Having shown by the figures which we have quoted, and by others of a similar significance the mileage made by wheels condemned for sharp flanges, and the percentages of such wheels to the totals removed, the committee next considers the various causes other than the form of the rail which might produce sharp flanges, viz.: Difference in diameter of wheels, trucks out of square, and bad quality of wheels. That all of these causes are active there can be no doubt, and the fact that more sharp flanges are found in freight than in passenger service is taken as evidence that they have considerable influence. It is pretty well demonstrated also that only one sharp flange occurs on an axle, and this is considered unmistakable evidence that "the primary cause of flange wear is not the rail, but some cause or causes which lead the axle to run more toward one rail than the other. For, since each wheel is subjected to precisely the same rail-wear, if the form of the rail only caused the flange-wear, we should expect to find each wheel equally flange-worn."

By way of ascertaining the effect of quality and make of wheels on sharp flanges the committee has summarized information obtained from the Erie in

TABLE No. 7.

*Summary of the percentages of wheels removed in 1884 on the New York, Lake Erie & Western Railroad for various causes.*

| | Six best makers. | Six next best. | Twelve worst makers. | Average of all on road. |
|---|---|---|---|---|
| Per cent. of whole number in service | 78.2 | 17.2 | 4.6 | 100.0 |
| Broken | 2.0 | 2.2 | 4.4 | 2.4 |
| Cracked | 12.2 | 23.7 | 37.2 | 19.4 |
| Broken and cracked. | 14.2 | 25.9 | 41.6 | 21.8 |
| Shelled out | 0.7 | 0.1 | 0.0 | 0.4 |
| Sharp flange | 2.7 | 8.2 | 12.4 | 5.8 |
| Slid flat | 22.3 | 21.1 | 20.3 | 21.7 |
| Worn flat and worn out. | 60.1 | 44.7 | 25.7 | 50.3 |
| Total removed | 100.0 | 100.0 | 100.0 | 100.0 |

*Percentage of total number in service removed for each cause.*

| | Six best makers. | Six next best. | Twelve worst. | Total. |
|---|---|---|---|---|
| Per cent. of whole number in service | 78.2 | 17.2 | 4.6 | 100.0 |
| Broken | 0.09 | 0.23 | 0.88 | 0.15 |
| Cracked | 0.54 | 2.60 | 7.50 | 1.20 |
| Broken and cracked | 0.63 | 2.83 | 8.38 | 1.35 |
| Shelled out | 0.03 | 0.01 | 0.00 | 0.02 |
| Sharp flange | 0.12 | 0.89 | 2.50 | 0.39 |
| Slid flat | 0.98 | 2.31 | 4.10 | 1.35 |
| Worn flat and worn out. | 2.63 | 4.90 | 5.18 | 3.13 |
| Total removed | 4.39 | 10.94 | 20.16 | 6.21 |

The ratio of sharp flanges to wheels worn flat and worn out is:

| | |
|---|---|
| Six best makers | 1 to 22.25 |
| Six next best makers | 1 to 5.45 |
| Twelve worst makers | 1 to 2.07 |

"This statement covers 15,595 removals from 250,973 wheels, made by twenty-four different makers, which were numbered by the mechanical department in order of relative merit, according to their best judgment, without a thought of the bearing of the table on this particular question. Because of being thus graded, and because few roads have so large a number of wheels from so many different makers, and with such careful records to abstract from, this record has particular interest."

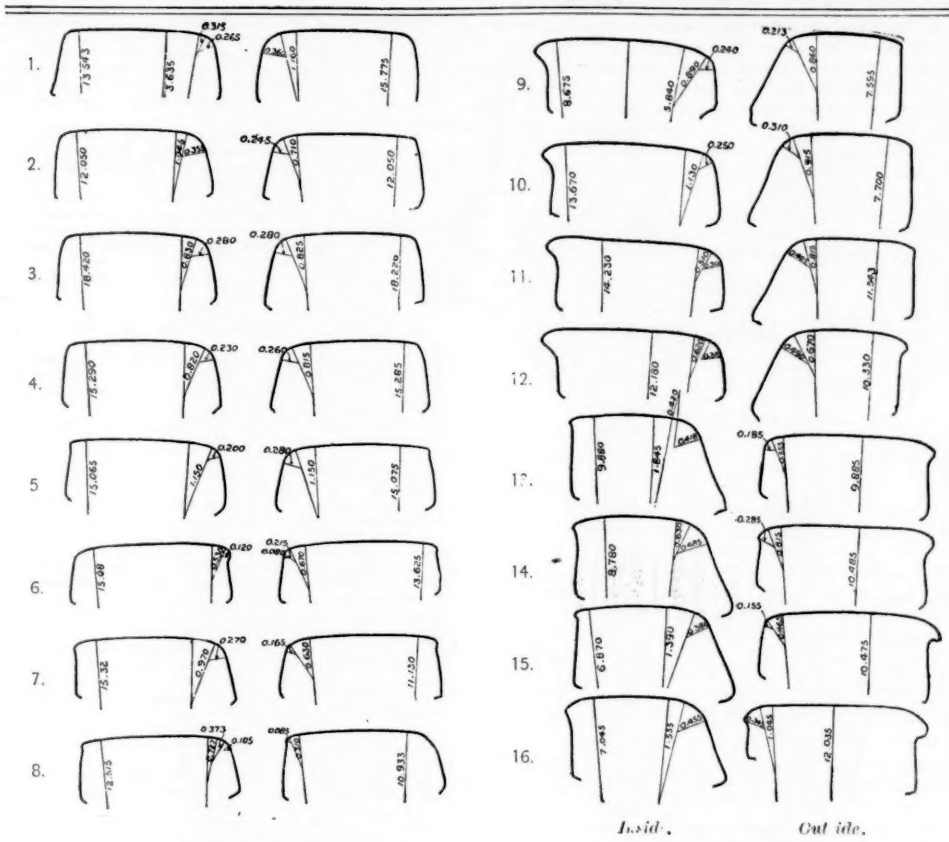
On this subject the committee says: "The evidence appears to indicate that the quality of the wheel has a very marked and decided influence on the proportion of sharp flanges, so much so that the proportion of sharp flanges is sometimes from four to twenty or even fifty times as great with one make of wheels as with another, the almost invariable rule being that the poorer wheels have much the larger proportion of sharp flanges. This fact also, if it be admitted to be such, clearly tends to indicate that the form of the rail has very little to do with sharp flanges. For, since both good wheels and bad wheels run over the same rails in the same kind of trucks (in the cars of any one road), the wear due to peculiarities of the rail should be distributed alike between flange and tread. Both flange and tread might be expected to wear faster in a bad wheel than in a good one, but there is no reason why the relative wear of either part should be faster in a bad wheel than a good one. On the other hand the most difficult part of a wheel to get a good chill on is the fillet of the flange, and it is but natural that badness of a wheel should show there first."

The committee devotes several pages to a discussion of the subject of rail wear, as modified by flange contact, the tendency being to show that the rate of wear on curves increases very rapidly as the rails become worn and as the surfaces in contact are increased. Of this part of the report and of the discussion of the theory of the question we make no abstract, but present some very interesting diagrams of worn rails taken by Mr. Thomas Rodd, Principal Assistant Engineer Pennsylvania Co., a member of the committee. These diagrams show admirably the shape taken by the upper corners of the rail heads on tangents and on curves at fast and slow speeds. The radii, as shown on the diagrams, are summed up in inches in the tables below:

TANGENT RAILS—FAST SPEED.

Edgar Thomson steel, 1876, 60 pounds per yard, gravel ballast.

| No. of cut. | Corner radii. Left. | Right. |
|---|---|---|
| 1 | .365 | 1.16 .36 |
| 1 | 1.045 | .255 0.71 .245 |
| 3 | 0.83 | .230 0.82 .28 |
| 4 | 0.82 | .23 0.815 .26 |
| Average | 0.900 | .270 0.876 .286 |




Tangent Rails. Curve Rails.

RADII OF WORN SURFACES, RAILS IN SERVICE—PENNSYLVANIA COMPANY.

TANGENT RAILS—SLOW SPEED.

Cambria steel, 1875, 60 pounds per yard, stone ballast.

| No. of cut. | | | Corner radii. Left. | | Right. | |
|---|---|---|---|---|---|---|
| 5, 1875 | Cambria | 1.15 | .20 | 1.15 | .28 | |
| 6, " | " | 0.53 | .12 | 0.67 | .215 | .008 |
| 7, " | " | 0.97 | .27 | 0.63 | 1.65 | |
| 8, " | " | 7.27 | .37 | 0.51 | 0.85 | |
| Average | | .844 | .240 | .740 | .211 | |

CURVE RAILS—FAST SPFED.

Pennsylvania, West Virginia State line; 7 deg., 20 ft.; 6½ in. elevation; stone ballast; Edgar Thomson steel, 1880; 67 lbs. per yard.

| | Outside. | | Inside. | |
|---|---|---|---|---|
| 9 | 0.86 | 0.213 | 0.24 | 0.89 |
| 10 | 0.915 | 0.310 | 0.25 | 1.13 |
| 11 | 0.815 | 0.405 | 0.30 | 0.51 |
| 12 | 0.670 | 0.490 | 0.31 | 0.70 |
| Average | 0.815 | 0.355 | 0.275 | 0.81 |

CURVE RAILS—SLOW SPEED.

Six degrees; Wheeling Junction; 5½ in. elevation; stone ballast; Edgar Thomson steel, 1880; 67 lbs. per yard.

| | Outside. | | Inside. | |
|---|---|---|---|---|
| 13 | .... | .418 | 0.185 | 0.555 |
| 14 | 0.630 | .485 | 0.285 | 0.615 |
| 15 | 1.390 | .380 | 0.155 | 0.465 |
| 16 | 1.555 | .455 | 0.345 | 1.045 |
| Average | 1.192 | .434 | 0.242 | 0.670 |

## The Westinghouse Friction Buffer.

The accompanying illustration represents a new form of car buffer invented by Mr. George Westinghouse, Jr., which, it is believed, will meet a want heretofore unfilled, namely, a device offering resistance to the inward movement of the draw-bar sufficient to absorb in itself the momentum of the load in ordinary working, in such a way that the shock and consequent injury to the car, hitherto considered inevitable, will be avoided.

The device in question consists of a cast-iron box to which a number of thin iron plates are secured. A like number of thin plates placed between those in the box are attached to movable pieces against which the draw-bar presses. When the draw-bar is driven inward, these thin plates are, by a simple wedge device, clamped or squeezed together so as to offer an immense frictional resistance to further inward movement. As this is aided by the resistance of the main springs (as now used), it is claimed that it will be possible to run one car into another at a speed of eight or ten miles an hour without fully exhausting the frictional resistance and compression of the springs.

It will be seen, on reference to the illustration, that the rear set of friction plates is attached to a casting which is bolted to the sills of the car. The other or front set of plates is attached to a casting which rides on a serrated washer which moves with the draw-bar. These two sets of plates overlap, as shown in the illustration. When the draw-bar is driven back the teeth mount, and the two sets of plates are clamped forcibly together. The consequent friction opposes any further movement.

The first spring has a resistance of about 9,000 lbs., and the pressure to the wedges is transmitted through this spring. When this spring is driven home, the front follower plate drives back the movable wedges, but as both sets of wedges now move together, there is no further tendency to clamp the plates more tightly. The front spring consequently acts as a sort of safety-valve to limit the resistance of the buffer. Experiments show that the actual resistance of the buffer is fully 60,000 lbs., and that any desired resistance can be obtained by varying the angle of the teeth or wedges and the resistance of the front spring.

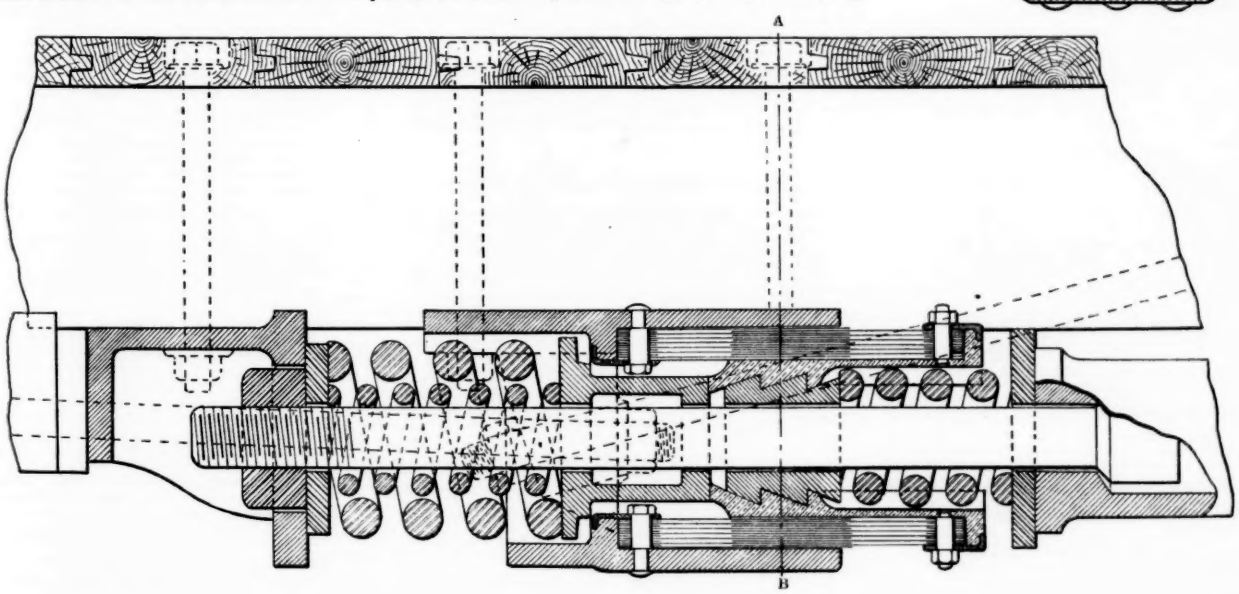
It is evident that where recoil is checked with springs alone, rebound is inevitable, while the extra resistance gained by friction acts only in one direction, and the effort to disengage the grip of the friction plates will probably absorb most of the power in the rebound of the spring. The only possible objection to this form of buffer would appear to be the possible variation in the amount of frictional resistance owing to difference in the condition of the rubbing surfaces. While the resistance would be greatly increased by rust or grit, it might on the other hand be diminished by moisture which would act as a lubricant. Experience in actual service alone can show whether these causes will have any serious effect on the amount of friction. The plates are tallowed when first put up, and being protected from any direct access of water, may be expected to remain free from rust. Even if the plates were considerably clogged, the springs would probably be sufficiently powerful to free the grip, and restore the buffer to its normal position when the buffing strain was released. On the other hand, if the frictional surfaces offered no resistance, the buffer would still be as efficient as an ordinary draw-bar, as precisely similar springs are used.

The friction plates offer a considerable resistance, which not only arrests momentum, but also checks the reaction of the main springs, at present a fertile cause of trains being broken in two.

The apparatus is applicable to any style of drawhead, but is especially designed to be used with the Janney type.

The sole makers, the Union Switch & Signal Co., state that the apparatus has been designed with reference to securing uniformity in draw-gear, and is applicable to all classes of cars, freight and passenger, and its peculiar construction admits of a new method of attaching draw-gear, which will give all the practical effect of a continuous draw-bar, if desired; and the saving effected in attaching the apparatus is nearly equal to the cost of the special casting and frictional parts.

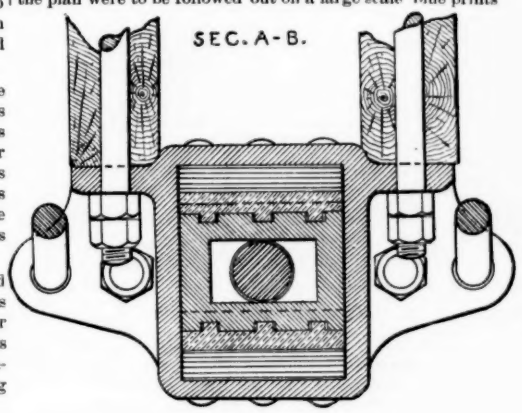
The Union Switch & Signal Co. proposes to manufacture and sell the apparatus, including the right to use, at rates that will justify its general adoption, and to reserve the manufacture of all of the special apparatus so required, thus insuring uniformity in this one particular throughout the country.




THE WESTINGHOUSE FRICTION BUFFER.

## Illustrated Catalogue of Train Signals.

General Superintendent Wade, of the Wabash, has issued a neat handbook showing blue prints illustrating the manner of carrying out the rules concerning the use of signals of all kinds. This handbook is somewhat of an experiment, and if the plan were to be followed out on a large scale blue prints



would have to be abandoned for regular book form with electrotype cuts. As the Time Convention has directed its Train Rule Committee to consider the advisability of getting up a work of this kind to go with the uniform code prepared by that body, it is reasonable to suppose that a compilation of illustrations of this sort will meet the approval of a great many superintendents and others. We therefore give herewith copies of a few of Mr. Wade's drawings, which will give a good idea of the whole work.

The first four cuts in the Wabash book show the position of tail lights and tail flags on passenger cars and freight cabooses. In these there is no novelty. The rule for cabooses is to show one red light in the top of the clear-story, and combination (green and red) at the sides. This shows red to the rear similar to fig. 3 of the illustrations shown in the *Railroad Gazette* of June 29 last. When the locomotive has to carry white signals, indicating that it is an extra, the signal, whether flag or light, is shown as at *A*, fig. 7. When running forward and carrying signals for a train following the green flag or light is shown in the same position.

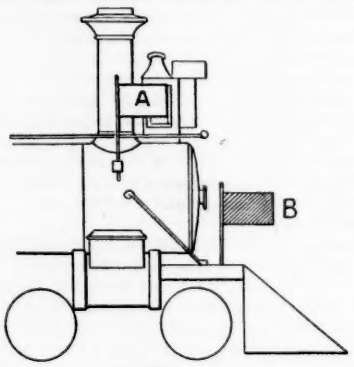



Fig. 7.

Locomotive Running Backward Empty and Running Extra. Rule: White Flags at A and Green Flags at B by Day.

When running backward, empty, at night and running extra, an engine shows white lights at *A*, and combination red and green, as at *B*, fig. 15. Other flag and lamp positions are shown in the cuts herewith.

The Wabash standard switch shows a red circular target 15 in. in diameter when the switch is set for side, cross-over

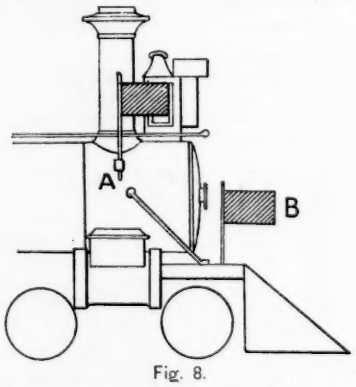



Fig. 8.

Locomotive Running Backward Empty and Carrying Signals for Train Following. Rule: Green Flags at A and B by Day.

or junction tracks, and a white target 15 in. *square* when switch is set for main track. The lights show red or white correspondingly. For side track switches wholly unconnected with the main line, but situated near it, and thus liable to be seen by the runners of trains passing at speed, targets and lights show white for a siding or passing track

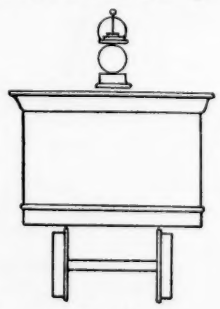


Fig. 13.

Locomotive Running Backward Empty. Rule: White Light by Night.

parallel to and adjoining the main track, and a circular green target (with a green light at night) when the switch is set for a yard track or for the track leading farthest away from the main track.

The book shows 41 illustrations in all, including, besides those named, headlights, showing condition for main track and side track; red, white, blue, green and green-and-white flags, showing standard size of flag and of stick; train-order signals, in both positions; semaphore switch stands, showing red arm horizontal when switch is set for side track; station distant semaphore signal; standard distance boards for one-half mile and one mile from grade crossings of railroads and stop board for same; railroad grade crossing signal, consisting of a board pivoted in the centre, which is to be held horizontally for one road and turned at an angle for the other. This board has red lights at either end, and is fixed at the top of a pole. The cut shows the cabin, resting on brackets, supported upon the signal mast, with floor 12 ft. above the ground. Whistling posts, marked S. W. (S. above W.) are set one-half mile from the outside switch of each station. One-half mile further away is the "mile board," with the name of the station painted upon it. If the station is a water station, "WATER TANK" appears on the board, and a

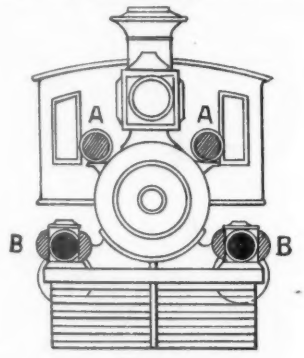



Fig. 15.

Locomotive Running Backward Empty, at Night, and Carrying Signals for Following Train. Rule: Green Lights at A and Combination Lights at B Showing Red to Rear and Green Front and Side.

"Water Tank" board is placed one mile from tanks located between stations. Highway crossings have a board marked X W (X above W), 80 rods distant. The regulation highway crossing signal, for the benefit of travelers, is also shown. The slow board is 2 ft. 6 in. long and 10 in. wide, with diagonal ends. The yard limit board is 3 ft. by 3 ft. The book shows the above, with dimensions, and all red or green boards or glasses are shown in colors.

## Theoretical and Practical Efficiency of Steam at High Pressures.*

In dealing with questions concerning the efficiency of the steam engine, it is usual to include the history of the steam after it leaves the steam engine cylinder. Inasmuch, however, as it is only that portion of its history which the steam spends in the cylinder, up to the period of exhaust, that admits of material modification, it is only that part which will now be considered.

The object of this paper is, firstly, to show that the CARNOT theorem is limited in its application to steam engine calculations of efficiency; and secondly, to show that high pressure steam must theoretically, as well as practically, be more efficient than lower-pressure steam. For some time it has been increasingly evident that the behavior of steam in a steam engine cylinder cannot be interpreted by laws that are true for a permanent gas, and that the actual efficiency of its action is not proportional to the range of temperature used in the cylinder. It has, on the contrary, become evident that the practical efficiency is much more nearly inversely proportional to the range of temperature in the cylinder. The efficiency of the actual steam engine cannot be usefully measured by any standard based on the Carnot theory of the perfect engine, as expressed by the relation $E = \frac{T - t}{T}$ that is to say, the relation which the range of temperature used bears to the absolute temperature is not an

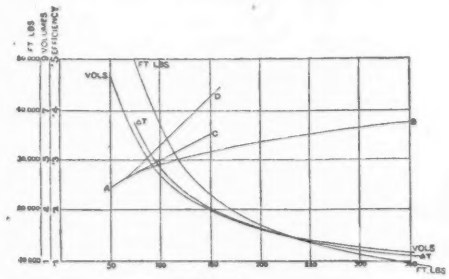



Fig. 1.

Efficency of High Pressure Steam.

index of efficiency. Modern practice has amply proved that the real efficiency of the steam engine has only been increased in proportion as the special character of the working fluid has been studied and provided for. The Carnot theorem ignores the nature of the working fluid, and the endeavor to realize with steam the conditions of a Carnot engine have led to delay in the development of the steam engine.

It has now been demonstrated, both experimentally and on the largest practical scale, that the most efficient working is obtained with steam when it is used so that the range of temperature in one cylinder is small. The expansive energy of steam at a high pressure can therefore only be utilized by expansion in several stages—that is to say, by passing it from one cylinder to another until the minimum working temperature or pressure is reached. The number of cylinders so required has been found to depend chiefly upon the maximum range of pressure economically permissible in each cylinder. By augmenting the number of stages of expansion, steam pressure has been usefully increased to about 180 lbs. per sq. in., instead of about 75 lbs., which, with the simple engine was found to give results little, if at all, inferior to those obtained with a higher pressure.

Formerly it was commonly assumed, chiefly as a deduction from Carnot's theorem, that there could be little gain as a result of the use of high-pressure steam, because the thermal value increased so slowly as compared with the increase in pressure. Upon the same grounds it is now generally held that the present state of our knowledge indicates that a pressure of about 200 lbs. will give results equal to those which are possible with any higher pressure. This argument is in strict accordance with the Carnot function already mentioned, and it is this argument which I propose to show is not necessarily a true one.

On the diagram, fig. 1, is a curve $A - B$, which shows, according to Carnot's theorem, the ideal efficiency of the steam engine as a heat engine, using steam at pressures of from 50 lbs. to 350 lbs. as marked along the abscissæ. From this it will be seen that the rate of increase of efficiency rapidly falls as the pressures increase. The temperature of steam, for instance, at 50 lbs. pressure absolute, being 281 deg., and taking 100 deg. as the lower temperature, or that of the steam engine condenser, the efficiency ratio $E = \frac{T - t}{T} = \frac{281 - 100}{281 + 460} = \frac{181}{741} = 0.242$. At 100 lbs., $E = 0.29$. This gives an ideal increase in efficiency of 0.048 for steam at 100 lbs. as compared with steam at 50 lbs. At 200 lbs. the efficiency ratio is 0.333, and at 250 lbs. $E = 0.349$. Thus the difference in the ideal efficiency as between 200 lbs. and 250 lbs. is only 0.016, so that according to Carnot the increase of efficiency attendant upon increasing the pressure of steam from 200 to 250 is $\frac{0.048}{0.016}$, or only one-third as much as for the 50 lbs. increase from 50 lbs. to 100 lbs. An increase in pressure from 300 lbs. to 350 lbs. gives an increase in efficiency measured in this way of only 0.01, or less than one-fourth that from 50 lbs. to 100 lbs. Thus, according to the Carnot theorem, the gain attending use of pressures the above about 150 lbs. could not, it has been assumed, be sufficient to counterbalance the practical disadvantages incurred. Experience has proved that this is the reverse of the truth. Every increase in pressure has secured an increase in actual efficiency which has been far more than is necessary to cover the increased cost of obtaining it. The *rate* of increase has been double that which the Carnot theorem indicates, and it has been amply shown that the engines made for and supplied with steam at a high pressure, work under conditions which are much much more nearly those required for maximum efficiency than do those engines which work with the lower pressure.

From the curve, fig. 1, it will be seen that by raising the steam pressure from 65 lbs. to 150 lbs. the efficiency ought to be increased by 21 per cent., or that a saving of 17 per cent. ought to be made. As a matter of fact, a saving of from 20 to more than 30 per cent. has been achieved, or an increase in efficiency as measured on the Carnot diagram from 25 to 43 per cent. Taking 25 per cent. economy, and for convenience of comparison starting from the Carnot curve at 65 lbs., the actual efficiency above that which is obtained when 65 lbs. steam is used reaches 33 per cent., or the height shown by the point *C*. Taking 30 per cent. as the saving, the relative actual efficiency reaches the point *D*.

It is clear, then, either that the high pressure engine is remarkably efficient, or that the low pressure simple engine is remarkably inefficient. No explanation has yet been given of the cause of the great difference; but it is the object of this paper to show that there are fundamental reasons for it, which have hitherto been overlooked. Steam can only be varied in the efficiency of its employment by variation of the conditions which affect the advantageous utilization of its expansive energy. Now as the total heat of a volume of steam, say 1 lb., is within a few units as great after expansion as before it, nearly all the fall in the quantity of heat takes place when the steam leaves the steam engine cylinder. To compare, then, the relative values of steam used expansively at low and at high pressures, it is desirable to examine the relative conditions of expansion through a given range of pressure before exhaust occurs, as for instance, from 100 lbs. to 50 lbs., or 200 lbs. to 150 lbs.

A pound of steam at a pressure of 350 lbs. on the square inch and a temperature of 432 degrees F., or 892 degrees absolute, has a volume of 1·35 cu. ft. A pound of steam at 300 lbs., and a temperature of 417 degrees F.—877 degrees absolute—has a volume of 1·565 cu. ft. Assuming the pound of steam at 350 lbs. pressure to have expanded down to a pressure of 300 lbs., it will have fallen in temperature 15 degrees. The mean pressure during the expansion from volume 1·35 to volume 1·565 will be 343 lbs., and this pressure acting through the range of expansion of 0·215 ft. represents 10,372 foot-pounds.* The work done by expansion per degree fall in temperature is thus 691 foot-pounds. Again, 1 lb. of steam at 300 lbs. expanding from its volume of 1·565 to 1·853 and 250 lbs pressure falls in temperature 16 degrees; while the mean pressure during the fall will be 295 lbs., representing through the range of expansion 0·288 ft.—12,235 foot-pounds—or 765 foot-pounds per degree fall in temperature.

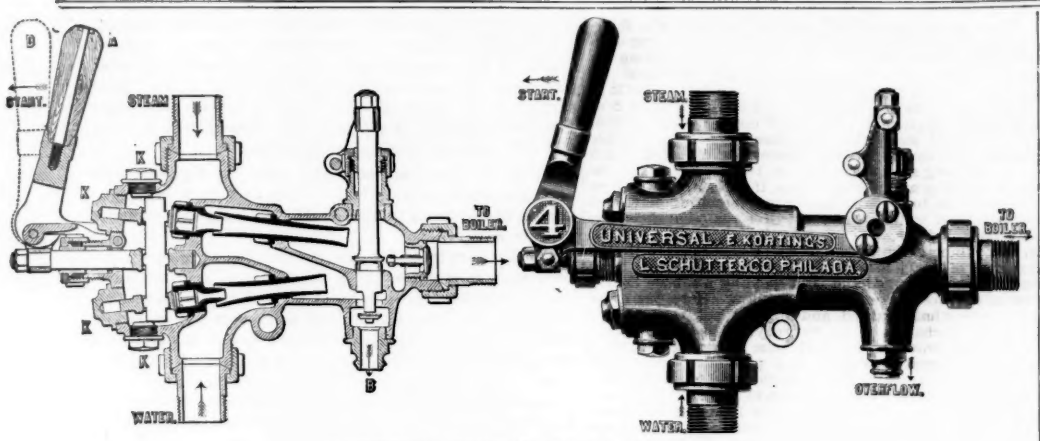
Following the pressures, temperatures and volumes, in the same way, of the pound of steam in expanding from 250 lbs. to 200 lbs., it appears that between these two, the fall in temperature is 19.5 deg., the expansion work represents 15,170 foot-pounds, or equal to 773 foot-pounds per degree fall in temperature. Between steam at 100 lbs. and at 50 lbs. there is a difference of temperature of 46.8 degrees, and the work represented by the expansion of the steam from one volume to the other is 49,280 foot-pounds, so that the expansion work per degree fall in temperature is 1,053 foot-pounds. There is thus per degree fall in temperature of steam expanding from 350 lbs. and from 100 lbs. respectively, a difference of $1,053 - 691 = 362$ foot-pounds of work done. The expansion work done by steam between 100 lbs. and 50 lbs. pressure is then apparently $\frac{362}{691} = .52$, or 52 per cent. greater per degree fall in temperature than with steam expanding from 350 to 300. These figures are given in column 12 of the appended table, and from them it can be readily seen how far is the departure from proportionality between fall in temperature and work done during expansion. Plotting a curve with the differences of temperature, $\triangle T$ for ordinates, but increasing the value of the ordinates by a constant quantity so as to get the curve into a position for ready comparison with the curve of foot pounds of work done by expansion in volume, we have the curve marked $\triangle T$.

In all cases it will be seen that the quantity of work represented by expansion from one pressure to a lower at high pressure, is less per degree fall in temperature than at low pressures. It will be seen, therefore, that if heat disappears in proportion to the fall in temperature work done, that the low-pressure engine cylinder for a given range of pressure must require more heat, either from a steam jacket, or from steam liquefied on entering the cylinder during the admission part of the stroke, than the high-pressure cylinder.

These considerations help to show wherein lies the great advantages that arise from the use of high pressures and multiple stage expansion. With the exception of a very

* Paper read before the British Association, Sept. 1888, by W. Worby Beaumont, M. Inst. C. E.

* The volumes taken are those of saturated steam at the pressures given. Mean pressure between these has been assumed to follow a hyperbolic curve. This curve between two near points will be practically identical with the saturation curve, and the mean pressures given will not be inaccurate from this cause.




UNIVERSAL DOUBLE TUBE INJECTOR.

*Made by* L. SCHUTTE & Co., *Philadelphia.*

small quantity, a steam engine gives up in its exhaust steam nearly all the heat that the steam contained on entering. By increasing the pressures used, an extra number of stages of expansion may be obtained at a small extra expenditure of heat in the boiler. The difference $\triangle H$ between the total heat of steam at 300 lbs. and at 250 lbs. is under five units, but the work done by expansion from 300 lbs. to 250 lbs. is 12,240 ft.-lbs., or about 2,400 ft.-lbs. per unit of heat employed in raising the pressure from 250 lbs. to 300 lbs. The work done per unit of heat disappearing on expansion for each stage of 50 lbs. is given in col. 11 of the table. By adopting high pressures and short stages of expansion the arrival of the evil time of exhaust is delayed, and the method of delay is of the greatest importance. With a small range of expansion not only is fall in the temperature on the working side of the piston kept down, but the temperature on the opposite side of the piston is kept up; so that the difference in temperature on the opposite sides of the piston is small. The new steam, in fact, expands in a warm cylinder kept warm under conditions which involve no loss.

The conclusions to which I am at present inclined, although this paper is only a preliminary consideration of the subject as put forth, are:

(1) That the work done with steam in a steam engine cylinder is not proportional to the range in temperature.

(2) That steam pressures much above 200 lbs. on the square inch may be used with advantage.

(3) That a small range of pressure should be used in each cylinder.

(4) That the number of cylinders should be as large as mechanical considerations will allow.

(5) That the economy obtained by multiple stage expansion engines, as compared with single stage expansion, is due to the small difference of temperature in a cylinder on the opposite sides of its piston, to the opportunity which the protracted working history of the steam gives, for the utilizable re-evaporation of the steam which is condensed in providing the difference between the heat represented by work done during expansion, and the heat which corresponds to the change in volume, and to the larger quantity of work done during expansion at high pressures per unit of extra heat required to raise steam at the higher instead of the lower pressure.

*Theoretical and Practical Efficiency of Steam at High Pressures.*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total pressure..... | Temperature $T$. | Difference in temperatures $\triangle T$. | Volume, cu. ft. | Difference in volumes $\triangle V = V^1$. | Ratio of expansion $\frac{V^1}{V} = R$. | Work done during expansion.... | Efficiency $E = \frac{T-t}{T}$ | Difference in efficiencies $= \triangle E$. | Work done by expansion per 1 deg. fall in $T$..... | Col. 7 / $\triangle H$ |
| 1 | 50 | 281.0 | 46.8 | 8.354 | 3.980 | 1.91 | 49,280 | 0.242 | 0.048 | 1.053 | 3,460 |
| 2 | 100 | 327.8 | 30.5 | 4.377 | 1.389 | 1.46 | 28,000 | 0.290 | 0.025 | 918 | 2,998 |
| 3 | 150 | 358.3 | 23.3 | 2.988 | 0.706 | 1.33 | 19,454 | 0.315 | 0.018 | 835 | 2,714 |
| 4 | 200 | 381.5 | 19.5 | 2.282 | 0.429 | 1.25 | 15,089 | 0.333 | 0.016 | 773 | 2,605 |
| 5 | 250 | 401.0 | 16.0 | 1.853 | 0.288 | 1.20 | 12,240 | 0.349 | 0.013 | 765 | 2,458 |
| 6 | 300 | 417.0 | 15.0 | 1.565 | 0.210 | 1.16 | 10,372 | 0.362 | 0.010 | 691 | 2,930 |
| 7 | 350 | 432.0 | | 1.350 | | | | 0.372 | | | |

## Schutte's Universal Double Tube Injector.

The accompanying illustrations represent an improved Korting injector, lately introduced by Messrs. L. Schutte & Co., of Philadelphia.

The makers claim that this improved universal injector combines the most desirable features in a higher degree that were embodied in the three different styles formerly manufactured by this company. As will be seen in the sectional view the connections have been made symmetrical and at the same time have been adjusted to such an area as to prevent any loss by friction from excessive speed of the water and at the same time prevent loss through change of speed into pressure or pressure into speed.

It is claimed that the action of this injector is positive; it works to the same advantage and fulfills the same duty under all circumstances: with high or low pressure steam, hot or cold water, water under pressure or suction.

The instrument is a combination of two steam jet apparatus, the first one proportioned for lifting and delivering the water, under some pressure, into the second one, where its velocity is sufficiently augmented to overcome the counter pressure in the boiler.

The explanation of the proper working of the injector, at the lowest as well as the highest steam pressures, without any adjustments of parts, is found in the fact that the quantity of water taken in by the first apparatus and delivered to the second one is in proportion to the pressure of the steam, so that the first one acts as a governor for the second one.

The explanation of the feeding of hot as well as cold water is found in the construction and proportion of the first apparatus, which has a proportionately small steam nozzle, to insure high suction; and as the water is delivered to the second one under pressure, its temperature can correspond to this pressure, and may be delivered into the boiler above the boiling point.

The makers state that as the combined area of the two steam nozzles is smaller than that of other injectors of the same capacity, so that its duty must, necessarily, be higher. This combination of the two apparatus, and the self governing qualities without moving parts, make the apparatus the least sensitive and most reliable for any service.

The injector is preferably fixed in a horizontal position, so that it may drain itself when not in operation.

During working hours the stop valve on boiler (which may be any kind of a valve) remains turned on, and the stopping and starting is solely effected by the lever $A$, operating the valves in the steam chamber of injector.

With water flowing to the injector, or under a 4 ft. suction, and with a steam pressure of 60 lbs., the admissible temperature for any size of this injector (½ in. to 3 in.) is 150 degrees Fahr. With higher steam pressure and higher suction the temperature must be lower.

The following table gives the capacity of the sizes most generally used on locomotives. The table is made from results obtained from actual tests under a suction of 4 ft. and a supply temperature of 80 deg. Fahr. Under different conditions the capacity is affected approximately as given below, the steam pressure being from 60 to 100 lbs. per sq. in.:

| | Per cent. |
|---|---|
| With water of lower temperature..... | 5 increase. |
| " " " higher " ..... | 5 decrease. |
| " " flowing to injector..... | 5 increase. |
| " " under 10 ft. suction..... | 5 to 10 decrease. |
| " " " 15 ft. " ..... | 15 to 25 decrease. |
| " " " 20 ft. " ..... | 20 to 35 decrease. |

| Locomotive cylinder, dia. | Size injector No.... | Size of iron pipe connections, in..... | Pressure of steam, in lbs. 90 | | 120 | | 150 | | Size of copper pipe, outside diam., in. |
|---|---|---|---|---|---|---|---|---|---|
| | | | Cubic ft. per hour. | Gallons per hour. | Cubic ft. per hour. | Gallons per hour. | Cubic ft. per hour. | Gallons per hour. | |
| 14 in.-16 in... | 6.. | 1¼ | 128 | 960 | 136 | 1,020 | 150 | 1,125 | 1½ |
| 16 in.-17 in... | 7.. | 1½ | 172 | 1,290 | 195 | 1,462 | 215 | 1,612 | 1¾ |
| 17 in.-18 in... | 8.. | 1½ | 225 | 1,687 | 255 | 1,912 | 282 | 2,115 | 1¾ |
| 18 in.-20 in... | 9.. | 2 | 270 | 2,025 | 300 | 2,250 | 330 | 2,475 | 2¼ |
| Above 20 in.. | 10.. | 2 | 315 | 2,362 | 345 | 2,587 | 380 | 2,850 | 2¼ |

Injectors of both considerably smaller and larger capacity than those given above are also made by Messrs. L. Schutte & Co., from whom any further information may be obtained.

## Electric Welding.*

Since the first of the year there has been a commercial application of electric welding, the invention of Prof. Elihu Thomson, which has already reached a degree of importance sufficient to render it a live issue in every branch of manufacture to which it has been shown to be applicable.

This process is a new art, for unlike the smith who is confined to iron, steel and platinum, it can weld any two pieces of the same metal or alloy ranging from the most refractory metals to the alloy which fuses at 162 deg. Fah. It will join dissimilar metals when the welding point of one is not too far in excess of the fusion point of the other.

*The Process.*—In the electric welding process, the two pieces to be joined are secured in firm end contact by a pair of adjustable copper clamps which are placed upon the top of the apparatus. An electric current of large volume is passed through the pieces, and the contact between them being of less conductivity than the homogeneous metal, heating ensues at this place, as the juncture is brought to the proper temperature by the gradual motion of the regulating lever, and as the metal softens the clamps are pressed toward each other to insure a continuous metallic union across the bar. The weld begins at the centre and proceeds radially toward the surface, as the temperature becomes greater than at the interior. The heating is further increased by the fact that the resistance of the hot metal is greater than that of cold metal.

The enormous electric currents used in this welding process sometimes reach 50,000 ampères, but with an electromotive force of half a volt, and therefore not capable of giving any sensation to a person.

It would be injudicious to offer any premium upon ignorance, but the operation of electric welding is one of the simplest of mechanical processes, requiring but little skill on the part of the operator in comparison with that exact training of hand and eye, and long experience, necessary for ordinary welding. The operator must understand the color of the proper welding heat of the metal under treatment, but this is readily learned. The work is not manipulated during the process, except when it is desired to reduce the burr at the weld, and is at all times under observation, and its heat subject to entire control by means of a lever which graduates the strength of the current.

The dynamo generating the electricity is self-regulating, and requires no attention except for lubrication. There is no unnecessary waste of fuel, the heating being local, and not extending far from the weld; cotton-covered wire one-fourth of an inch in diameter can be welded without searing the insulation over three-fourths of an inch from the weld. The time for making a weld varies from a fraction of a second to about two minutes, according to the work; although nothing over two inches diameter has yet been welded, but larger machines are in process of construction. It is not necessary to provide motive power fully equal to the maximum demand, as the time is so short that the momentum of a fly-wheel will serve the same purpose as in a drop press, and give up the surplus energy required.

*Applications.*—The process is far cheaper than that of hand welding, and also extends to other methods of manufacture, but the comparative expense differs according to the previous conditions in every place where it has been applied thus far.

Its applications in practical work thus far have been confined to butt welding for many purposes, such as continuous wire work, carriage work, axles and tires, cotton bale ties, barrel hoops and wire cables and many miscellaneous purposes. Axes are made of drop forgings, joining the tool steel edge to a mild steel poll, bars are heated in the middle and upset forming collars, and pipes are joined together—a matter of great value in ice machines. The list might be continued to greater length, but this indicates the range of its practical uses at this early day.

*Strength of Electric Welds.*—The value of the process, for most purposes, independent of any scientific interest or mechanical ingenuity shown in the apparatus, must be that of the resistance of the welds under tensile stress.

It will be readily understood, however, that, as this process accomplishes many things hitherto impossible, aside from any question of ultimate strength, it is fitted for applications in many constructions where it saves labor and time; provided only that the joints be in all cases sufficiently good for the purpose for which the article is designed. A large field thus opens up in the execution of ornamental design in metal work, where it will supplant screws, rivets or solder for fastenings, and in other evident applications.

There is no reason why such a weld should be stronger than the rest of the bar, but if averaging of equal strength some of the breaks would occur at the weld. There have been many tests made on various testing machines, but it has been considered preferable to submit only the official record of tests made on the Emery testing machine at the United States Arsenal at Watertown, Mass.

### DISCUSSION.

Mr. Ralph W. Pope: Mr. President and gentlemen, Some of the points which I wished to discuss have already been touched upon; but there have been various questions and surmises raised in regard to the perfection of the electric welding process, and I heard from one mechanic who has a very high national reputation, that he thought that the metal might be burned. I wish to say in regard to this that we should not confound this process, in any respect, with the electric arc as seen in the ordinary arc lamp which we all know will fuse metals. The conditions are entirely different. I wish to inquire of Mr. Woodbury in regard to the burr at the joint, whether that burr can be reduced in the process so as to reduce the size of the weld to that of the bar. This apparatus, as you know, has been brought out in the electrical field. It has been touched upon by various electrical societies, and been discussed in the electrical journals, but it properly belongs to the domain of the mechanical engineer. The process has been developed by one of the brightest electrical men in the field to-day, and I feel sure that he would not have brought it to its present state of development, and influenced the investment of quite a large amount of money and the construction of valuable machinery especially for this work unless he was certain that there was something in it. In regard to the burning of the metal, if I may be permitted, I will read a letter from Prof. Dolbear which I came across to-day, and which is quite interesting and goes to confirm the tests that have been made later. This letter was in reply to an inquiry from the editor of the *Engineering and Building Record*, who had seen a statement that a certain European process of welding had burnt the metal. He referred this paragraph to Prof. Dolbear, who replied as follows:

"I have made nearly a hundred tests of the tensile strength of electrically welded bars of iron, steel and other metals. The results were of such a character that I can state positively that with Thomson's welding process it is possible to weld both wrought iron and steel so that the weld is as strong as the same cross-section in another part of the bar; that the appearance of the fracture is fibrous for iron and gener-

* An abstract of a paper presented by Mr. C. J. H. Woodbury at the Scranton meeting of the American Society of Mechanical Engineers.

REPORTS OF TESTS BY TENSION OF BARS JOINED BY ELECTRIC WELDS, AT THE TESTING MACHINE, U. S. ARSENAL, WATERTOWN, MASS.

| Metal. | Sectional areas. At weld... | Sectional areas. Of bar..... | Tensile strength. Total lbs.. | Tensile strength. Lbs. sq. in. in bar... | Position of fracture. |
|---|---|---|---|---|---|
| | Sq. in. | Sq. in. | | | |
| Wrt. iron..... | 2.39 | 1.77 | 79,640 | 45,070 | 3½ in. from middle of weld. |
| " ..... | 1.17 | 1.21 | 57,900 | 49,500 | At weld. |
| " ..... | 7.85 | 7.85 | 42,690 | 54,380 | 3 in. from weld. |
| " ..... | ..... | .408 | 21,920 | 53,730 | |
| " ..... | ..... | .408 | 21,840 | 53,530 | |
| " ..... | ..... | .408 | 22,780 | 55,830 | |
| " ..... | .408 | .408 | 20,100 | 49,260 | At weld. |
| " ..... | .408 | .408 | 21,020 | 51,520 | " |
| " ..... | .562 | .408 | 21,820 | 53,480 | 3 in. from weld. |
| " ..... | .513 | .408 | 21,810 | 53,480 | At weld. |
| " ..... | .513 | .408 | 20,400 | 50,000 | " |
| " ..... | .602 | .408 | 22,240 | 54,510 | 2¼ in. from weld. |
| " ..... | .555 | .408 | 21,780 | 53,380 | 3.7 " " |
| " ..... | ..... | .196 | 12,520 | 63,880 | |
| " ..... | ..... | .196 | 11,160 | 56,940 | At the grip. |
| " ..... | ..... | .196 | 10,520 | 53,670 | |
| " ..... | .189 | .186 | 7,690 | 39,230 | At weld. |
| " ..... | .196 | .196 | 9,980 | 50,920 | " |
| " ..... | .283 | .196 | 10,260 | 52,350 | 1½ in. from weld. |
| " ..... | .283 | .196 | 10,280 | 52,450 | 1.6 " " |
| " ..... | .246 | .186 | 11,080 | 56,530 | 1.75 " " |
| " ..... | .292 | .190 | 10,270 | 52,400 | 1.8 " " |
| " ..... | .253 | .196 | 11,170 | 56,990 | 1.5 " " |
| " ..... | .353 | .196 | 10,060 | 51,330 | 1.7 " " |
| " ..... | .374 | .196 | 10,120 | 51,630 | 1.5 " " |
| " ..... | ..... | .302 | 15,700 | 51,990 | |
| " ..... | ..... | .302 | 17,980 | 59,540 | |
| Octagonal steel. | ..... | .360 | 45,800 | 127,220 | |
| " " | ..... | .360 | 45,670 | 126,860 | At face of grips. |
| " " | .360 | .360 | 27,500 | 76,390 | At weld. |
| " " | .372 | .360 | 22,900 | 63,610 | " |
| " " | .531 | .360 | 32,550 | 90,420 | At end of enlarged section of weld. |
| " " | .502 | .360 | 37,800 | 105,000 | At end of enlarged section of weld. |
| Octagonal steel and wrt. iron.. | .332 | .328 | 17,100 | 52,130 | In iron, 3 in. from weld. |
| Octagonal steel and wrt. iron.. | .442 i'n | .328 | 17,070 | 52,040 | In iron, 2.3 in. from weld. |
| Octagonal steel and wrt. iron.. | .466 | .328 | 16,950 | 51,680 | In iron, 2.8 in. from weld. |
| Copper..... | ..... | .109 | 3,580 | 32,840 | |
| " ..... | ..... | .109 | 3,540 | 32,480 | |
| " ..... | ..... | .109 | 3,530 | 32,390 | |
| " ..... | .113 | .109 | 3,210 | 29,450 | At weld. |
| " ..... | .113 | .109 | 3,390 | 31,100 | " |
| " ..... | .109 | .109 | 3,470 | 31,830 | " |
| " ..... | .113 | .109 | 3,590 | 32,940 | ¾ in. from weld. |
| " ..... | .204 | .109 | 3,540 | 32,480 | ¾ " " |
| " ..... | .196 | .109 | 3,570 | 32,750 | .85 " " |
| Brass and wrt. iron..... | | .110 | 1,920 | 17,450 | At weld. |
| Brass and wrt. iron..... | Brass | .110 | 3,690 | 33,550 | " |
| Steel and German silver..... | .086 | .049 | 1,980 | 40,410 | " |
| Copper..... | .112 | .109 | 3,520 | 32,290 | " |
| Wrt. iron..... | .363 | .196 | 11,420 | 58,370 | 1.3 in. from weld. |
| | .385 | .196 | 10,410 | 53,110 | 1.7 " " |
| Steel..... | .200 | .199 | 15,290 | 76,830 | At weld. |
| " ..... | .302 | .196 | 21,700 | 110,710 | 8 in. from weld. |
| " ..... | .196 | .195 | 14,590 | 74,820 | At or near weld. |
| " ..... | .... | .198 | 18,900 | 75,450 | Near end of heated section. |
| " ..... | .302 | .196 | 20,420 | 104,180 | 9 in. from weld. |
| Octagonal steel. | .557 | .250 | 31,190 | 124,760 | At weld. |
| " " | .278 | .250 | 33,580 | 134,320 | At weld. |
| " " | .250 | .250 | 32,350 | 129,400 | 3 in. from weld. |
| " " | .250 | .250 | 33,700 | 134,800 | At weld. |
| Steel..... | .... | .302 | 19,610 | 64,930 | |
| " ..... | .503 | .302 | 19,490 | 64,540 | 9 in. from weld. |
| " ..... | .302 | .302 | 19,020 | 62,980 | At weld. |
| Wrought iron... | .... | .312 | 16,360 | 52,440 | |
| " " ... | .312 | .312 | 16,280 | 52,180 | At or near weld. |
| " " ... | .312 | .312 | 16,160 | 51,790 | At or near weld. |
| " " ... | .407 | .312 | 16,750 | 53,690 | 2.4 in. from weld. |
| " " ... | .454 | .454 | 24,550 | 54,070 | At weld. |
| " " ... | .608 | .608 | 25,590 | 42,100 | 2 in. from weld. |
| " " ... | .515 | .515 | 25,380 | 49,300 | 2 in. from weld. |
| Steel..... | .203 | .198 | 15,300 | 77,270 | At or near weld. |

ally granular for steel, the strength of this granular steel being on some samples as high as 125,000 lbs. per square in.; that the process is such that the welding is homogeneous from necessity. I had a number of bars welded by an expert blacksmith, and a number of similar ones by the electrical process for comparison, with the result that the electrically welded bars were much stronger than those welded by the ordinary process. The bars were of various sizes, up to an inch and a half for iron, and three-fourths of an inch octagon steel."

Mr. Wheelock: Mr. Chairman, I would like to join in the discussion to the extent of adding my testimony to the value of this process and to show what my experience has been recently in the matter of screws $\frac{1}{16}$ of an inch in diameter and 5½ ft. long, which are troublesome things to make and to repair when they become broken. It occurred to me that I would try the electrical process of welding. I sent some screws to the works and they came back the next morning perfection. The lead of the screw was perfect, without any change, and the only change was in the diagonal break, which might have been perhaps $\frac{3}{8}$ of an inch, and the strength of the screw at that point was beyond question as great as ever, only requiring to be cut at the point of $\frac{3}{4}$ upset. When you consider the many ways this process can be used practically it seems to me it should receive the encouragement of every mechanic. Take locomotive tubes where they get worn at the fire-box end and it is necessary to renew them, throw them away. You can take this machine, as I see it, put the 3 or 4 in. of tube on, and the remainder of the tube having only been slightly worn can be made useful indefinitely. It seems to me that any one who has any experience should give their encouragement to this very important matter.

Mr. Oberlin Smith: I think that to any one who knows anything about ordinary blacksmithing—and probably that critic who spoke about burning up steel did not—there would be no fear of steel being burned by this process any more than in a blacksmith's fire, and not as much. There is nothing mysterious about the action of electricity on the metal. It simply heats it. That heat is under perfect control. There are no impurities coming up out of the fire—sulphur, smoke and other stuff—to damage the steel; no danger of the fire getting ahead of you; no danger of heating the bottom of the bar while the top remains cool. Of course we have to heat steel up to a certain definite degree to weld it in any shape, say to its melting point, and as this process does it more uniformly, neatly and under much better control, and with a great deal more cleanliness than any possible blacksmith's fire can do it, there cannot possibly be as much danger of burning steel as there is in that case. It can be protected by plugs and in other ways, if necessary. All there is to do to it is to bring it up barely to the melting point and press it together, so that it is impossible that that objection should have any force.

Mr. Woodbury: The question was asked relative to the enlargement of the joints at the portion of the weld. One difficulty with ordinary hand butt welding has been the reduction of the cross section by the process. Here the cross section is somewhat enlarged, and that has not been considered a defect in chains; on the contrary, it has a tendency to prevent a chain from kinking. In some of the special forms of this welding apparatus there is a pair of swedges that strike a blow on the metal as soon as the weld is effected, for the purpose of reducing both surfaces to a smooth joint, as, for example, in the joining of old cotton bale ties, the operator by placing his foot upon a treadle strikes a blow upon the weld and reduces it to uniform section. There is an addition to the process of chain manufacture to which I have not alluded, because it has not yet been developed to a commercial basis, and that is the method of making an electric welded chain by machinery passing the rods into the machine where they are cut, bent and joined, then welding the chain in a thorough manner and passing it out at the other end of the device.

## Design and Construction of a Culvert.

In the *Railroad Gazette* of May 25 was published an account of the construction of a masonry culvert on the Indianapolis, Decatur & Springfield Ry., by Mr. E. A. Hill, who was formerly chief engineer of that road. At the request of the editor of the *Railway Age*, Mr. Hill contributes to that journal some discussion of the considerations which governed in the design of the work. He says:

"Mr. Boynton's queries may be summed up briefly in three words, viz., frost, undermining and undue pressure.

"And first as to frost: Indiana has a milder climate than Iowa. Our roadmaster considered 3 ft. the limit of frost in the given locality. I, though with less local experience than he, should say four rather than three; but in any case, with a culvert 200 ft. long, buried out of sight under 50 or 60 ft. of embankment, frost could only affect the foundations at the wing walls and apron except by entering the bore of the culvert and penetrating through the pavement or invert. Now in winter the temperature within will be warmer than without, and the frost will have to penetrate through about 2 ft. of solid stone invert, and as well also through the layer of ice which will form on the invert and apron to a depth of several inches. Snow and ice are notable non-conductors, and I take it frost will not penetrate as deeply in solid masonry as in earth. It is evident, therefore, that frost within the culvert will not go nearly as deep as it will without. Hence, a reason for deepening the foundations at the portals, which feature was embodied in the original plan which carried down all foundations 3 ft. below the top of invert for a distance of about 6 ft. into the culvert. The discovery of quicksand, as described in the paper, made it impossible to carry them to this depth at the south portal without the use of timbers, and the published drawings are for the modified construction used at the south portal only, the foundations at the north end being carried down 3 ft. as per original plan. The question arose as to the power of frost to penetrate the one foot of masonry and additional foot of concrete, 2 ft in all, forming the apron on which the wings of the south portal are started. I considered this an experiment which the management were willing to try, and as yet they have had no cause for regret. Here, of course, the formation of ice upon the apron again comes in to protect the foundations as the earth backs closely up against the wings, preventing the access of frost from behind.

"Second, as to the question of undermining. Here again the quicksand forced modified plans upon us at the south or down-stream end. The original plan called for a solid barrier of masonry carried across the mouth of culvert, 3 ft. wide and 3 ft. deep below top of invert; likewise a second barrier or curb of stone 1 foot wide and 3 ft. deep carried across the end of the apron. This construction was carried out at the north portal (plan not published), but at the south portal was interfered with by the quicksand. I suggested the precaution of paving the bed of the stream for a distance below the apron at the south, or down-stream, end to prevent the clay stratum from washing away and letting out the quicksand from under the apron, but it was concluded to watch the action of the stream and see first whether this was really needed or not, and the final result, as will be seen, proved the wisdom of the suggestion. Through the trunk of the culvert I do not see how foundations can be undermined until after the invert has been washed away. This invert was laid in rubble, but was laid in blocks carefully broken so as to form a rough but nevertheless true, inverted arch, and the whole was then cemented by an A No. 1 quality of German Portland cement mortar of the brand (Alsen's) used in *coignet béton* and artificial stone work. Hence the invert is, so to speak, monolithic in structure, and likely to prove an efficient barrier against any water tending to undermine the foundations.

"Lastly, is the pressure per square foot of foundation such that we should anticipate settlement? Can we estimate this pressure either exactly or with reasonable approximation, and if so what will it amount to in the given case? Some might argue after the following fashion: The invert can sustain but little of the surcharge and must be neglected and we will then have about 8 sq. ft. of soil sustaining a prism of material 70 ft. high, 14 ft. wide and 1 ft. thick, assuming train load as equivalent to three additional feet in height of bank. Now averaging earth and stone at 130 lbs. per cubic foot we get a load of 127,400 lbs. sustained by 8 sq. ft. of surface indicating a pressure of about 8 tons per square foot; but practically there are many reasons why nothing like such a pressure could even be realized.

"1. If the invert is constructed with any degree of care whatever, on the first settling of the side walls it takes up a portion of the stress, to that extent relieving the soil under the side walls.

"2. No mere theory of the pressure of earthwork will exactly apply in practice, for in no two cases are the various conditions alike; generally speaking we may say that with a fill 60 or 70 ft. high and a long culvert or pipe under it, much of the central pressure is carried to and sustained by the ends of the structure; how much it is probably impossible to say. Theory might possibly work out a maximum centre pressure that could not be exceeded which would be much less than the pressure obtained above, but even then this would be more or less reduced according to the varying conditions.

* * *

"Suppose now, after allowing for all of these indeterminate deductions from the theoretical pressures obtained by calculation, we consider the case of the Nichol's Hollow culvert, viz., a culvert with a strong invert to distribute the pressure over the entire foundation, area 14 ft. instead of 8 ft., of span, and deduct for the effects of hillside slopes and distribution of pressure over 200 ft. of culvert length, and consider that we are filling with moist clay, not sand, dumped from a trestle and falling about 60 ft. Evidently after filling in this way to a depth of 35 ft. we shall be far from approximating to the conditions of fluid pressure, and our material will be compacted about as solidly as we ever find it in new work. Now suspend the work for the winter and next spring you will find that the additional material put in the fill will not greatly increase the centre pressures on the culvert. I presume many will recall instances of where a culvert or drain pipe has washed away from under an old and compacted embankment carrying a highway, or it may be a railroad, and yet the natural arch formed by the compacted soil after the culvert has been carried out has sufficed to carry the traffic until the damage was discovered and repaired. This will illustrate what I mean when I say that the thorough compacting of the earth in high embankments begun in construction and continued by the processes of nature tends to equalize the pressure over the entire foundations, and by forming such a natural arch over any pipe or culvert built under the same tends to relieve it from excessive pressure; and that the maximum stress from the surcharge comes upon the culvert during the process of filling in, and grows less from year to year as the embankment becomes more and more solid, and moreover falls short of the theoretical pressures by a difference increasing rapidly with the increase of surcharge."

Mr. Hill gives the following particulars of the action of this culvert:

"The culvert was finished and the embankment raised about 35 ft. over the extrados before frost came in the fall of 1887, after which the structure was left to itself. When spring opened I made a careful inspection and found the alignment through the arch absolutely perfect, with no signs of settling or of the action of frost or water on the invert side walls, archings, wing walls or apron; everything remained unchanged and as constructed the previous summer. A little later, under the action of the spring floods, the unprotected bed of the brook below the apron at the south or down stream portal, somewhat as we had anticipated, washed out to a depth of 18 in. over a surface of about 10 sq. ft. This hole was filled up with heavy rip-rap from the quarry. The water at this time ran about 2½ ft. deep in the culvert, the rain being quite a heavy one.

"Since I left the service of the I., D. & W. an unusual fall of rain has occurred, which put the structure to a severe test, and while some further trouble was experienced with the bed of the brook below, the culvert itself stood intact, doing its duty in every respect. The storm was the most severe but one in the history of the locality. At this time for an hour or two the water rose faster than the carrying capacity of the culvert, and dammed up on the upper side until the water stood 3 ft. above the extrados of the arch. The only perceptible effect of this cloud burst was to wash out the riprap and bed of the brook below the apron, making a hole below the apron about 18 ft. square and varying in depth from 2 to 6 ft., but as before not reaching back far enough to affect the stability of the apron. Mr. Diddle, the I., D. & W. roadmaster, informs me that he filled the hole with riprap up to within 10 in. of the upper surface, then added 8 in. of concrete, and finished with 2 in. of strong cement mortar, thus virtually extending the apron 18 ft. further down the stream. He then carried a stone curbing 3 ft. in depth and 1 ft. wide across the lower end of the extended apron and built out the wing walls to the line of the curb, thus giving the water a chance to spread out with the idea of reducing its cutting power. Mr. Diddle reports that the alignment is still perfect through the arch, and that the work shows no signs of settlement anywhere, with no indications of heaving from frost either about the wings, aprons or anywhere else. Neither does the invert show any signs of yielding or humping up in the middle; in short, he reports that the culvert remains exactly as it was when finished, being thus far unaffected by frost, floods and the pressure of the completed fill, for the dirt is now within two or three feet of the top of the rails, standing about 65 ft. above the bed of the brook."


Fig. 3.

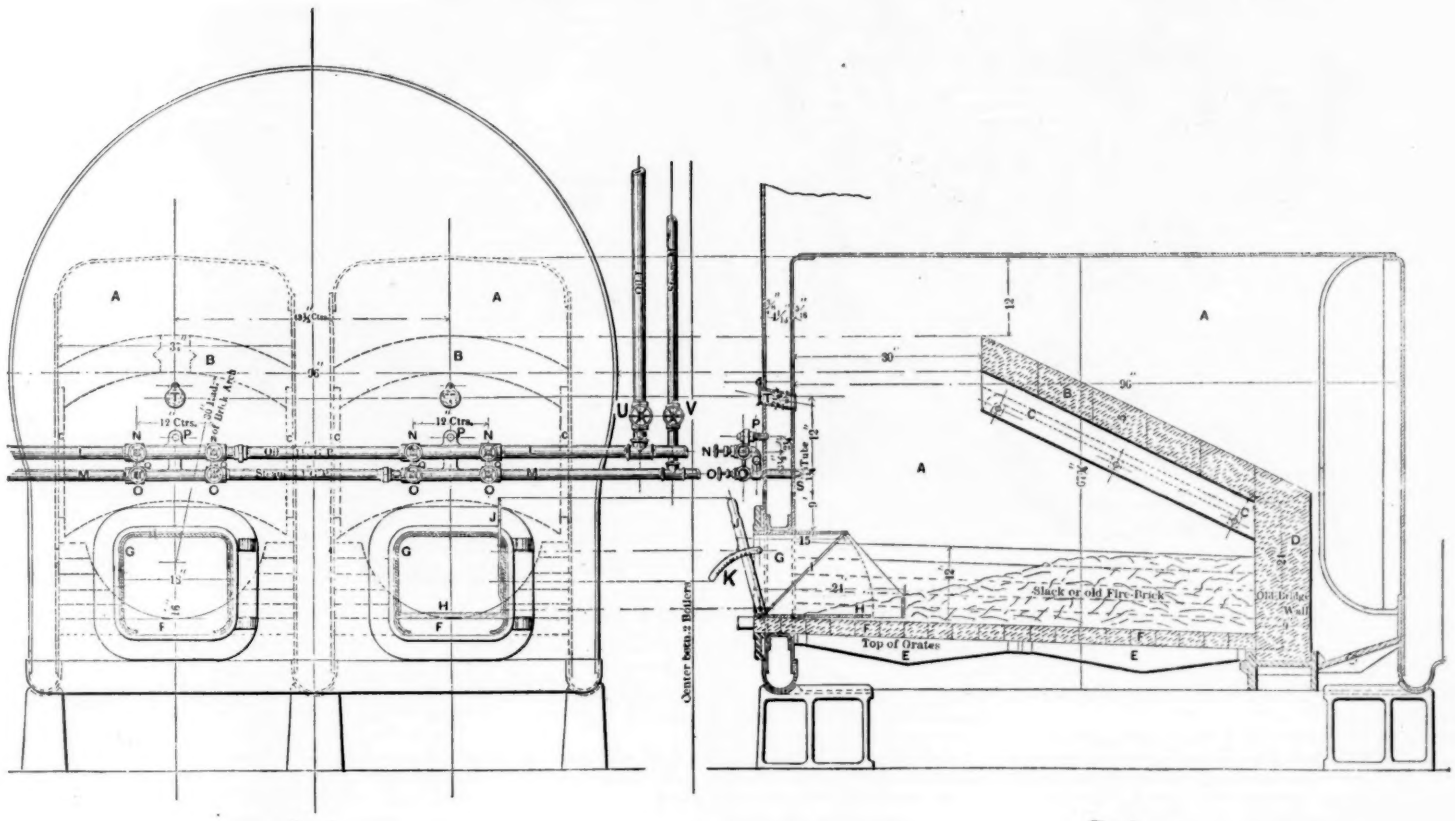



Fig. 1. Fig 2

STEAM VAPORIZING OIL BURNER.

*Designed by* MR. A. J. STEVENS, *General Master Mechanic Central Pacific.*

## Notes on Fuel and Combustion.

By R. H. BUEL, C.E.

### IV.

LIQUID FUEL.

Under this head are classed mineral oil, commonly known as *petroleum;* the volatile constituents of this oil, such as *benzine, naphtha* and *gasoline;* the refine product, *kerosene*, and the residuum of the distillation, or *tar*.

The principal deposits of petroleum in the United States occur in New York, Pennsylvania and Ohio. The composition of the oil is not uniform, but the following figures represent fair average values:

*Parts by Weight in* 100.

| | Carbon. | Hydrogen. | Oxygen. |
|---|---|---|---|
| Crude petroleum | 85 | 13 | 2 |
| Refined petroleum (kerosene) | 72.6 | 27.4 | |

Petroleum is ordinarily sold by the barrel of 42 U. S. liquid gallons, and its average weight is $6\frac{7}{10}$ pounds per gallon. The following table, based on these data, will be found useful in practice:

*Weight and Volume of Crude Petroleum.*

| Pound. | U. S. liquid gal. | Barrel. | Gross ton. |
|---|---|---|---|
| 1 | .1449 | .003451 | .0004464 |
| 6.9 | 1 | .02381 | .003081 |
| 289.8 | 42 | 1 | .1294 |
| 2240 | 324.6 | 7.73 | 1 |

The relative economy of petroleum and coal for use as fuel has been the subject of much discussion. The price of petroleum being quite variable, it is obvious that the foregoing problem can be solved in favor of either variety of fuel by using appropriate data. The range of prices for which petroleum has been sold in the United States are exemplified below:

*Price of Petroleum Per Barrel.*

| | |
|---|---|
| Lowest monthly average (January, 1863) | $0.10 |
| Highest " " (July, 1864) | 12.125 |
| Lowest yearly average (1882) | 0.78875 |
| Highest " " (1864) | 9.875 |
| General average | 1.6333 |

There have been numerous experiments on the evaporative power of crude petroleum when burned in the furnaces of steam boilers; but the records of comparative tests, when coal and petroleum were used alternately in the same furnace, are somewhat rare. The following figures show good average results (1st case), and results which may be classed among the best hitherto attained (2d case):

| | | 1st case. | 2d. case. |
|---|---|---|---|
| Pounds of water evaporated from and at 212° Fahrenheit. | Per pound of coal | 7.3 | 10.68 |
| | Per pound of crude petroleum | 15.04 | 15.41 |

Using the above values, which cover the general range of practice, the comparative economy of coal and petroleum has been calculated and arranged in a convenient form for reference.

*Comparative Value of Coal and Crude Petroleum as Fuel.*

| | | 1st case. | 2d case. |
|---|---|---|---|
| Price of coal per gross ton, to produce same effect as petroleum. (Coal is the cheaper fuel, if its price per gross ton is less than the amount given in this table; and petroleum is the cheaper fuel, in the contrary case.) | Oil at $0.75 per barrel = $5.80 per gross ton. | $2.81 | $4.02 |
| | Oil at $1 per barrel = $7.73 per gross ton. | 3.75 | 5.36 |
| | Oil at $1.50 per barrel = $11.60 per gross ton. | 5.63 | 8.04 |
| | Oil at $2 per barrel = $15.46 per gross ton. | 7.49 | 10.71 |

In comparing the relative cost of solid and liquid fuel, all the items of expense incident to the use of coal, such as wages of coal passers, cost of removing ashes, etc., should be reduced to cost per ton, and added to the price of the coal delivered. In the case of boiler plants where several firemen are employed when coal is used, a reduction of the working force can often be affected by substituting petroleum; and whenever this is the case, the saving should be credited to the liquid fuel.

The methods of burning petroleum vary greatly, judged by the number of devices which have been patented and brought into use, but nearly all of these devices can be classed under one of the following heads:

1. Burning the liquid petroleum in shallow vessels.

2. Vaporizing the petroleum before burning: *a.* By steam; *b.* By compressed air.

The great majority of oil burners consist of instruments bearing some resemblance to injectors, which vaporize the petroleum just before its admission into the furnace, the supply-jet being usually located in a fitting which replaces the ordinary furnace door. As the flame resulting from the combustion of the vaporized petroleum is very intense and is projected with considerable force, similar to the flame of a blow-pipe, an arch of fire-brick upon which the flame can impinge is frequently placed in the furnace to prevent destructive action upon the boiler-plates.

Although a great deal of ingenuity has been displayed by inventors in devising oil burners with carefully graduated jets and numerous adjustments, it is doubtful whether the refinements do not often sacrifice substantial gains for the sake of insignificant advantages. Some years ago the writer conducted an extended series of experiments on liquid fuel, testing all the prominent steam vaporizers then in the market, making the conditions alike in each case, and measuring the amount of steam used by each burner for vaporizing the oil. Each burner was tried at the maximum rate of combustion and at a reduced rate. Excluding the burners which did not completely vaporize the oil, it was assumed that the best burner was the one which gave the highest effective evaporation (that is, total evaporation, less evaporation required for the burner), per pound of oil, and which could burn the greatest weight of oil in a given time. Many of the burners tested were costly machines, with numerous adjustments, but the burner which was incomparably the best, judged by the conditions stated above, was a device consisting of a simple casting, and sold to consumers for the enormous price of $1.75. It is believed that the experience of many other engineers leads them to the same conclusion; that a simple jet apparatus, proportioned for complete vaporization and maximum delivery of oil, without internal adjustments and fitted with valves or cocks for regulating the supply of steam and oil, is as efficient a form of steam-vaporizing oil-burner as can be constructed.

The general details of the experiments to which reference has been made may interest the reader.

A cylindrical tubular boiler, set in brick work, was used; diameter of shell, 48 in.; length, 15 ft.; 48 tubes, outside diameter, 3 in.; grate surface, 15.2 sq. ft.; heating surface, 680.8 sq. ft.

The number of tests was 31, and the range of results was as follows:

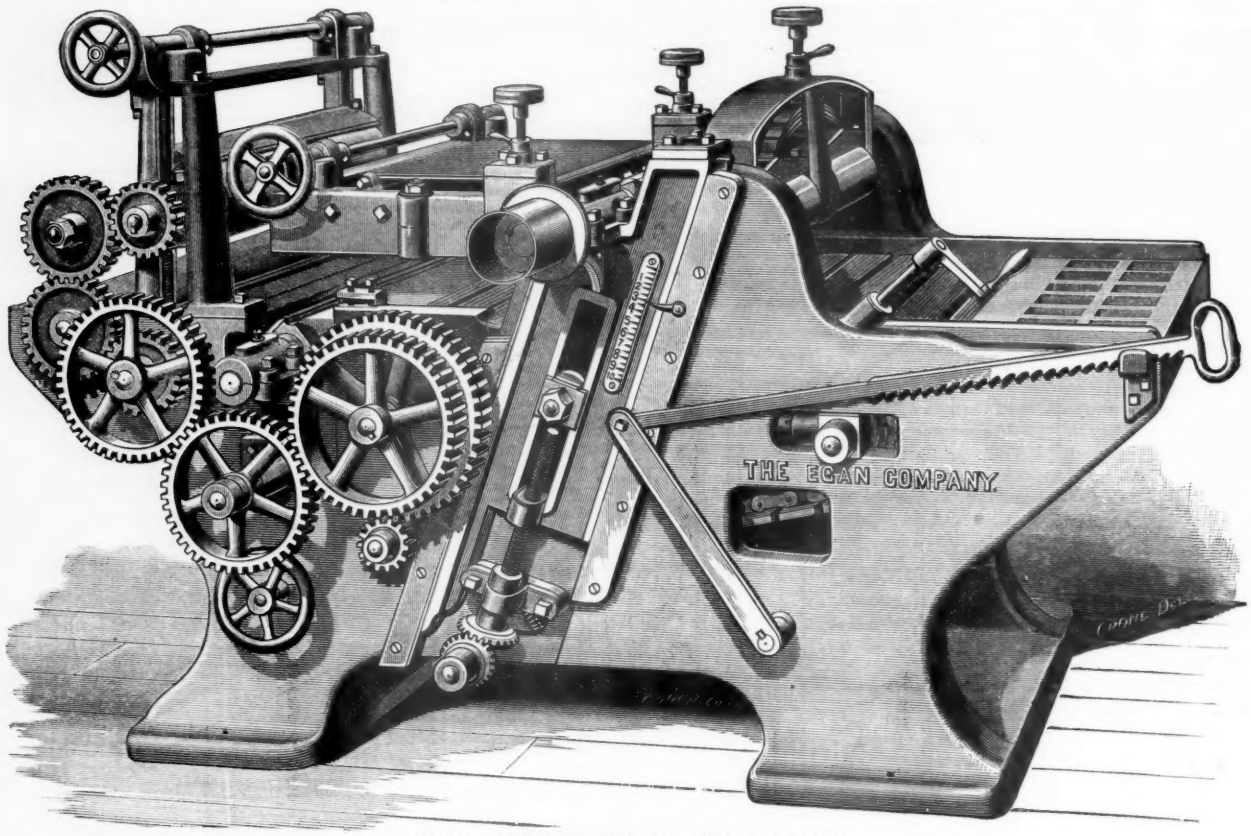
| | Pounds of oil burned per hour. |
|---|---|
| Total | 61.3 to 143.1 |
| Per square foot of grate surface | 4.03 to 9.41 |
| | **Pounds of water evaporated hourly from and at 212° Fahrenheit for vaporizing oil.** |
| Total | 99 to 263 |
| Per cent. of total evaporation | 6.2 to 31.1 |
| Effective evaporation (real evaporation, less evaporation for burner), from and at 212° Fahrenheit, per pound of oil, pounds | 12.21 to 15.04 |
| Horse-power developed, based on an effective evaporation of 30 lbs. of water hourly, from and at 212° Fahrenheit | 19.1 to 50.9 |

The same boiler was tested, using first class coal as fuel, and the best results obtained are stated below:

| | Pounds of coal burned per hour. |
|---|---|
| Total | 109 |
| Per square foot of grate surface | 7.17 |
| Pounds of water evaporated from and at 212° Fahrenheit per pound of coal | 7.3 |
| Horse-power developed | 23.1 |

The foregoing figures show one decided advantage of petroleum over coal, as fuel, the greater capacity or power of the boiler, when oil is used; and this advantage is one which will be appreciated by many steam users.

The results obtained by burning the residuum (consisting principally of tar) left by the refinement of petroleum, are about the same as those produced by the burning of crude oil. The burners are also the same, except that when the




DOUBLE CYLINDER ENDLESS BED SURFACER.

*Made by* THE EGAN CO., *Cincinnati, O.*

residuum is very thick, it must be heated sufficiently to make it flow freely.

The literature treating of liquid fuel is quite extensive, and contains illustrations and descriptions of hundreds of burners, the reproduction of which would only bewilder the reader, and it will be sufficient to describe two practical and efficient forms, representing methods of vaporizing the oil by steam and by compressed air.

Figures 1 to 3 show the construction and application of a steam vaporizing oil burner, designed by Mr. A. J. Stevens, General Master Mechanic of the Central Pacific Railroad, for use on the steamer "Solano." These sketches were first published in the *American Machinist* for Aug. 1, 1885. The construction of the burner and mode of application are plainly represented. The furnace *A* is converted into a retort, by covering the grate-bars *E* with fire-bricks *F*, and building an arch *B* of fire-brick, supported by a bar *C*. An air regulator *G* contains a damper, shown open at *H*, and closed at *I*; its position being controlled by a lever *J* working in a rack *K*. The steam pipes *M* for the burner are connected to the burner at *Q*. There is a regulating valve *O* for the steam, and another *N* for the oil, in the oil pipe *L*. The burners are attached to the boiler by studs *P*. The steam pipe *R* of the burner is narrowed down at the end to a slit, as shown in end-view, Fig. 1. The oil pipe *S* of the burner has wires at the end to break up the oil into spray. There are peep-holes *T* at the front of the boiler; and stop valves are provided, *U* for the oil, and *V* for the steam.

Mr. Stevens states that the performance of this burner is perfectly satisfactory; that steam can be raised in a boiler from cold water in thirty minutes, and that when burning refuse or residuum petroleum, the oil is about 50 per cent. cheaper than coal.

The oil burner manufactured by the Aerated Fuel Co., of Springfield, Mass., consists of a series of jets, connected to one or more oil reservoirs, from which the fuel is forced and vaporized by compressed air. The air-compressor, actuated by steam, is controlled by an automatic governor, so as to maintain the air pressure constant. The jets or oil burners are adjustable by hand-wheels, which regulate the relative amounts of air and oil admitted.

## Double Cylinder Endless Surfacer.

We illustrate herewith a new improved double surfacer with cylinder to raise and lower, and with a pair of feeding-out rolls for the lower cylinder. The makers, The Egan Company, of Cincinnati, Ohio, claim it is one of the most perfect tools of this class yet placed on the market.

The frame is of new design, and is made in such a way that it is exceedingly strong for its weight, as it is braced and ribbed on the inside, which makes it very stiff and solid; and is so arranged that the working parts are easily accessible.

The main cylinder raises and lowers by a crank from the working end of the machine. This cylinder is double belted, and the lips are of the very best cast steel and are brought up in such a manner that the knives hug them very firmly. The lower cylinder is on a standard bed and has an independent adjustment for a heavy or light cut.

The feed is powerful, and the board is fed entirely through without the aid of the operator. The feeding rolls for feeding out the board are geared and make a powerful feed, which takes the board entirely through the machine. This will be found a great convenience.

The pressure rolls are firmly weighted and hold the board solidly on a traveling bed. The bed frame being stationary, the slats are gibbed in an improved manner, so that the ends cannot be thrown into the cylinder.

The broken roll is a great improvement on this machine and works on an improved principle. Two boards of uneven thickness can be fed through at the same time.

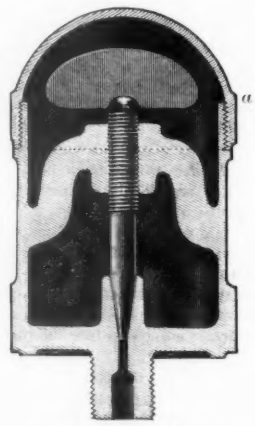
Two sizes of this machine are built. One to plane 26 in. wide and 10 in. thick, and the other to plane 30 in. wide and 10 in. thick. This machine is suitable for first-class planing mills and car shops.

The makers claim that its capacity is extraordinary, and for first-class planing in either hard or soft wood it will excel any machine yet placed on the market.

For further information address the builders, The Egan Company, Cincinnati, O.

## Locomotive Oil Cup.

The accompanying illustration represents an oil cup lately introduced by Messrs. Pedrick & Ayer, of Philadelphia. The cup shown in section is intended for rods, but cups with the same internal arrangement are made for guides and truck brasses.




Locomotive Oil Cup.
*Made by* PEDRICK & AYER, *Philadelphia.*

The bracket-shaped piece in the interior of the cup is split open, and is wedged apart at the time that the screw is cut, so that it always, even after long use, clamps the spindle and holds it in any desired position without the aid of jamb nuts or binding screws. Around the edge of the cup at *a* there are marks by which the engineer can adjust the opening to feed the required amount, according to the temperature of the weather and the quality of oil used. When the engine is out of use it is only necessary to screw down the spindle and the flow of oil entirely stops. The oilers are made in two sizes.

As shown in the cut, the cover is screwed on, but it can also be made to slip on and be held by a spring catch. The cover of the guide oiler extends down to the hexagon for screwing the cup into place and has a small vent hole in the top to admit the air to facilitate feeding the oil, and also to allow the cover to be taken off readily. The internal arrangement is the same as in the rod cup.

The makers claim that the cup is simple and easily regulated and cleaned out, while the spindle remains in any position in which it is set. No special tools are required for adjustment. These cups are largely used by the Northern Pacific and Philadelphia & Reading.

## The Electric Railroad at Richmond, Va.

The American Institute of Electrical Engineers at its meeting Oct. 9 took up the discussion of the paper read before that body June 19, by Mr. Frank J. Sprague, on the Solution of the Municipal Rapid Transit Problem, which was a plea for electric traction, and was based on the experience obtained in the construction and operation of the Union Passenger Railway in Richmond, Va. The Institute was especially fortunate in being able to obtain from Mr. M. B Leonard, Superintendent of the Chesapeake & Ohio Railroad Telegraph, a contribution to the discussion, in which that gentleman gave some objections to the system of overhead construction as used in Richmond.

Mr. Leonard said that in working this question out it must be remembered that "the more haste, the less speed," and that before undertaking to surpass the locomotive it is wiser to prove its superiority over the horse or mule. Having accomplished this successfully, then it is time to endeavor to rival steam.

While it has been successfully demonstrated in the City of Richmond that electric traction is really the solution of the rapid transit problem, I have considered, from my daily observation of the operation of this electric road, that the overhead wire system cannot be made a perfect or ideal method of operation because of the defects inherent in such a method. But that it will serve as a pioneer in the new field and will be supplanted in time by a more perfect system I have not the least doubt. The latest report of electric street railroads in operation in America shows that, out of a total of 43, not less than 36 are using the overhead system, and that at least 30 now under construction have arranged to do so. During the seven months of active operation of the Richmond Union Passenger Railway many thousands of passengers have been successfully transported every day and at a very much lower cost than could possibly have been done by horse-power, owing to the excessive grades encountered, but the defects of the overhead system are now becoming more apparent as the plant suffers its material depreciation, and we are now in a better position to judge of its value as a permanent institution than we could possibly have been heretofore. It is an understood fact that the encumbering of the streets with the poles required for the overhead system is one of the most serious objections to its use. They are not only a grievous eyesore, but also increase the liability to accident from runaway horses and other causes. Their appearance would not, perhaps, be so offensive were it possible for them to maintain an erect position, but on account of the weight of the trolley wires, and the pressure of the trolley the tops of the poles are constantly pulled together, notwithstanding they may have at first been raked in the other direction, and thus the unsightly effect is augmented.

But to my mind the most serious objection is the employment of the bare trolley wire carrying a current of 500 volts and about 90 ampères, which I consider not only dangerous to life on account of frequent breakages of the wire, which upon one occasion last spring in falling struck and killed a horse, but also in damage to property by fire. That the trolley wire is liable to breakage at any time has been shown twice during the past week to the interruption of travel and dissatisfaction of the public, while not so very long ago the wires over one of the curves were pulled down on top of the car by the trolley catching in it, and travel entirely suspended on that part of the line for one or two days. A very serious defect in the use of the bare trolley wire is the difficulty of securing proper insulation.

After setting forth the difficulties which have been shown

in the practical operation of the most extensive system of electric traction in the world, it gives me pleasure to direct attention to the remarkable behavior of the Sprague motors under all the conditions to which they have been subjected for the past 7 months, which has been indeed remarkable. No load has been too heavy and no grade too steep for them to ascend. Perhaps the severest test they ever received was on the night of July 4, in bringing the crowds from the New Reservoir Park, when the ordinary open cars carried over 100 passengers and the closed cars over 75 each, so many in fact that the axles of one or two of the cars broke down under the load, all of which must be very satisfactory to the inventor, and places the Sprague motor at the very head of the very many excellent types or forms that have been devised at home and abroad.

The objections referred to apply equally well to all forms of overhead systems except where a second wire is used for a return instead of the track and earth, and also where the trolley pole is discarded for the movable trolley. But the increased number of aerial wires required, as well as the heavier fixtures needed to sustain them, render these systems just as objectionable.

We are very anxious to see the effect of ice, sleet and snow upon the operation of the road, as it has not yet passed through a winter in complete working order. A heavy sleet storm has often prostrated our telegraph lines, and I see no reason why the overhead electric railroad wires would be exempted from similar troubles, nor why the covering of the rails with ice and snow will not render it difficult to make a sufficient contact to operate the line successfully, not to speak of the loss of current by leakage or escape from the trolley wire.

The Secretary read a contribution to the discussion from Mr. Almon Robinson, of Lewiston, Me., who criticised the adoption of toothed gearing by Mr. Sprague, he being an advocate of frictional gearing, although confessing that experience was against its adoption for this work. "No one seems to notice," says Mr. Robinson, "that every day and on every railroad this method of transmission gets the roughest possible testing; that every locomotive pulls its train by frictional adhesion; that a rail and driving wheel are neither more nor less than a frictional rack and pinion. When we try to copy the work of a locomotive under other conditions then our troubles begin. But no man who has ever seen a freight engine climb a grade has any right to speak with disrespect of frictional gearing. I do not know that anything has been suggested—I certainly cannot suggest anything—which does not leave, for the purpose under consideration, much to be determined by trial, but I cannot help thinking that a usable connection, which left the speed of the motor independent of that of the car, would be a valuable acquisition, and that a probability of obtaining it would amply justify further experiments with methods of gearing.

Mr. Sprague said: I am perfectly frank in acknowledging that a great many of the deficiencies mentioned exist in Richmond, and unless the machines were of superhuman design they must exist there. A year ago these machines were put in in a great hurry. The maximum normal capacity that these machines ought to run at was 7 to 7½ horse-power. Very frequently, almost every day, they run 11 and 12 horse-power, an increase of 60 or 70 per cent. In the nine months during which this road has been in actual operation while the cars have run nearly a million of miles and carried millions of passengers, not one car has ever been inside of a closed shed. They have been housed in the street. When a machine is running it is exposed to more or less wear. It needs something of care and attention. A locomotive that makes two or three hundred miles is sent into a round-house, thoroughly overhauled, cleaned and taken care of. It is a very good locomotive that will run with safety, and it is a very poor management that will permit it to run more than two or three or four hundred miles without looking it over. The Richmond machines have run sometimes as high as 8,000 or 10,000 miles without being sent inside a covered shed. They have run without covers of any kind or character. They have run with the street 6 in. deep in water and brake-beams running in the water, and the water splashing on the machine. They have run until you could not tell what the machine was—until the accumulation of mud and oil and filth was of such a character that no other piece of machinery in the world would ever have run.

The breaking of a trolley wire, sometimes caused by a trolley catching in it, can be, of course, obviated by one or two precautions. One of these is the non-use of solder in the erection of a line. In putting up the Richmond line we used hard-drawn copper. Hard-drawn copper as it comes out of the mill has remarkable tenacity, but when it has been handled and when under the heat of the soldering iron it has been warmed up, you reduce it practically to the strength of soft-drawn copper; so that you will have at the point where soldering has been applied a weak spot which entirely nullifies all your other precautions. In our future work this trouble will be entirely removed, because we we will not use solder from one end of the line to the other. The use of silicon bronze or aluminum bronze drawn for high conductivity and great tenacity will likewise render less possible any accidents due to the breaking of the wire.

If the poles are set in concrete there is no reason why they should bend. One of the most important roads that we have—we have some 26 or 27 now—is the West End road of Boston, rights for an overhead system having been granted within a few days there, we are putting up a line that costs four times as much per mile as that in Richmond did. Instead of putting in wooden poles we are putting in iron poles tested up to 1,400 lbs. Instead of setting them in clay we set them in concrete. Now those poles will not come down; so far as the span wires are concerned, they cannot come down.

## Education of Engineer Apprentices.

The Manchester Association of Engineers has issued a syllabus embracing a course of study which might be recommended by the association, for the purpose of guiding youths engaged in engineering workshops in the study of the different branches of science specially bearing upon their occupations. In this country few young men get their training as engineers in shops and offices. Far the greater number of them are educated in technical schools, with prescribed courses of study; nevertheless there are many, both students and teachers, to whom the Manchester syllabus will be of interest.

It opens with a couple of tabulated lists of the different branches of science, entering more or less into engineering work, from which the student can ascertain the course of reading and study most essential in acquiring a thorough technical training in whatever branch of engineering work he may be engaged. Following these tables is a series of useful notes and general observations on each of the different subjects, which form a very valuable further guide to the student. These notes deal with free-hand drawing, practical, plane and solid geometry, mechanical drawing, mathematics, theoretical mechanics, applied mechanics, sound, light and heat, magnetism and electricity, inorganic chemistry, metallurgy, steam, and the study of the French language.

For draughtsmen it is urged as desirable, and indeed almost essential, that a youth should first master one of the chief branches in the workshops before entering the drawing office, while in any case an intelligent interest should be taken in all the work in progress, with a thorough determination to master the principles of its construction. In this respect a youth should note that he will never be taught his business, but will have to acquire it almost entirely by his own observation and inquiry. The chief branches to which attention should be directed in study are mathematics, applied mechanics and steam, of which wide knowledge should be obtained. In addition to the study of pure science sketched in the syllabus, the pupil is strongly recommended to take advantage of any opportunity which presents itself, in the testing of machines and appliances used in engineering work, such as the indicating of engines, the use of the dynamometer and brakes, strength of materials and structures generally, testing of boilers, hydraulic tests, etc.

Another class dealt with is made up of erecters, fitters, turners and machine men. Apprentices in these branches should commence work in the shops between the ages of fourteen and sixteen, so that they may serve at least five years to that branch of the trade which suits their abilities the best before they come of age. Turners and machine men should pay special attention to mechanical drawing and applied mechanics, and to the nature and composition of metals. The former also require a sufficient knowledge of mathematics to enable them to calculate the wheels required for the cutting of all kinds of screws to standard. Erecters and fitters should work hard at mechanical drawing, mathematics and applied mechanics, and a thorough knowledge of steam, with some knowledge of metals should be secured. The French language should be learnt by young men in these branches to enable them to translate specifications, to go abroad and fix machines, and to transact any mechanical or commercial business their employers might require, and a knowledge of strength of metals is highly desirable.

It is recommended that engineering chemists should spend one to three years in the laboratory of some engineering works, where experience in practical analysis could be obtained, a previous good general knowledge having been secured. An acquaintance with French and German is useful, the latter, indeed, being essential, not only on account of its direct commercial value, but also so that the chemist can keep himself fully conversant with the contemporary work of German chemists.

The young engineer who has decided to qualify himself for electrical engineering should, in addition to securing a thorough training in the actual workshop practice of general engineering, devote himself to the comprehensive study of pure science, as this forms an important factor in electrical engineering, and it is essential that he should give special care and attention to the study of mathematics, magnetism and electricity, sound, light and heat, so as to gain a thorough and perfect knowledge in these subjects, while he must not fail to secure an advanced attainment in theoretical and applied mechanics and metallurgy, as well as of machine and freehand drawing. It is further requisite that he should acquire a thorough understanding of steam and chemistry, together with a practical acquaintance of the various forms of motors that may be adopted for the generation of electricity. It would also be of great service to him to get a fair degree of proficiency in French and German. Though the course of study indicated may at first sight seem very severe, it is quite within the compass of the painstaking student, who should afterward obtain—which he will have fully deserved—the benefit of not less than one year's practical work in the service of some electrical engineering firm, that he may obtain a full and varied practical experience of electrical work, in order to thoroughly equip and educate himself.

With regard to boilermakers, smiths, bridgebuilders, and coppersmiths, the syllabus states that a knowledge of free-hand drawing will be found of the greatest possible service. Solid geometry will enable those who have only a fair knowledge of it to lay out on the flat plate such forms as dome bases, manhole seatings, intersections of cylinders, branches on pipes, camber in conical plates, large wrought-iron elbows, standpipes, spherical shaped ends, etc., all of which can be developed or laid out in the flat. Machine drawing is essential to enable a youth or workman to thoroughly understand and be able to work to a drawing, but he will really enjoy doing so when he can make his own drawings. He will find a most valuable pastime in making a freehand sketch of any article not usually met with, and then from his own notes make a mechanical drawing of the sketch. This subject will also give a thorough knowledge of the proportion of bolts, pins, stays, cotters, rods, and other details. Mathematics, applied mechanics, sound, light and heat, would also be most useful, and metallurgy should be learnt, or, at all events, such portions of it as refer to iron, steel and copper. Steam, and its capacity for work, should be studied by the smith and metal plate worker no less than by the engine maker, for the coppersmith and boilermaker make and equip the steam generator. The smith uses steam largely in hammers, and the bridgebuilder is greatly dependent on machines, cranes, and other appliances worked by steam.

## THE SCRAP HEAP.

### Notes.

A passenger train on the St. Louis, Iron Mountain & Southern was robbed near Diaz, Ark., Oct. 28, some $2,000 being taken from the express car and $50 from passengers in the sleeper. There was no door leading from the forward passenger car to the baggage car, and the train had to be stopped in order to get firearms out of the latter car; but immediately on the train coming to a stop the robbers took to the woods.

The crews of switching engines of the Michigan Central, Rock Island and Northwestern roads, indulged in a fight with the crew of a Burlington switch engine, at Air Line Bridge, Sixteenth street, Chicago, on Saturday night last, which culminated in a riot which lasted nearly an hour. A number of men were badly bruised. The police were sent for but did not arrive until after the yardmaster had restored order.

James Talmage, son of the late A. A. Talmage, was convicted at Keytesville, Mo., last week, of murder in the second degree, for killing C. P. Tidd, telegraph operator, at Brunswick, Mo., last January, during a quarrel over orders for the train of which young Talmage was conductor. He was sentenced to 21 years in the penitentiary.

On the Chicago, Burlington & Quincy, near Dubuque, Ia., last Sunday, a section master took his wife, three children and a young man for a ride on a hand car. They were overtaken by a train and the woman and two boys were killed.

Frederick Gebhard has sued the Erie for $190,000 damages for horses and other property destroyed at the Shohola accident last summer.

At Headingly, on the Canadian Pacific, last week, the employés of that road tore up the frogs of a crossing which the construction forces of the new provincial road had laid. At the same place on Monday night a Canadian Pacific bridge was saturated with oil and set afire, but was saved.

### Pass Forgers Held.

Harry Lewis, Tull B. Hutch, James Mackey and James Cline, who were charged with forgery in signing the names of stockmen to stockmen's passes, and then selling them to ticket scalpers, were held in $500 bail each in Chicago last week. The attorney for the Chicago, Burlington & Quincy appeared for the prosecution, though the cases on which the men are held were in connection with Chicago & Northwestern passes. All of the western roads are interested, however, and the detective work has been done more particularly in the interest of the Chicago, Burlington & Quincy. A portion of the evidence offered before Justice Lyon was that of Pinkerton's detectives and Burlington employés.

The arrest of several hotel runners on charges of selling forged railroad passes has given a set back to a system which, it seems, has been in vogue at the Stock Yards ever since they were established, over 20 years ago. Whether forgery direct has ever been practiced in connection with the sale of tickets it is hard to say; but the sale of tickets to scalpers and others has been indulged in almost daily for years. Says a local paper: Nobody ever seemed to consider the traffic illegal. Every shipper who brings cattle to the yards is allowed a pass for a man to every two cars up to three men. If he is posted, and he generally is, he secures two men who want to come to Chicago and do not intend to return. For these men he secures passes on contracts, possibly charging them $5 each for allowing them to go with him. He also specifies that on reaching Chicago they are to give him the return passes. On securing them the stockman looks about for a good market for the passes. If he fails, he keeps them until it is time to return. Then, in a fit of compulsory generosity, he gives the tickets to some hotel runner or agent for some clothing-house, who, in turn, finds a market for them. It is the purchaser who is then guilty of forgery. The tickets are made out in the name of the man who accompanied the stockman from the rural districts, and, in signing the stockman's name, the purchaser places himself liable. It is more than probable that if the detectives had made a diligent search they would have entrapped 100 men engaged in the business and making a fair competency."

### South African Notes.

The output of gold in South Africa for the month of August is estimated at 25,000 ounces, 19,877 having passed through the banks for that month, and as 4,500 ounces passed through private hands in July, the estimate of 25,000 ounces is thought to be correct. On this basis the production of the South African mines would be for the first eight months of this year 135,000 ounces. As the January output was 11,289, and as new companies are getting their stamping machinery and mines in working order, it is assumed that the monthly increase will continue so that the output for the year will be 250,000 ounces, valued at £900,000.

Solid improvements seem to be made in the Transvaal. The *Financial Times* has a long account of the ceremonies attending the laying of a corner-stone for a reservoir for the Johannesburg Water-works, which is laying down 9, 5 and 4-in. pipes and erecting pumping works. A concession has just been granted for lighting Johannesburg and Pretoria with electric lights.

The revenue of the Natal Government railroads in August was £22,326 15s. 3d., against £16,856 10s. 2d. for the same month in 1887. Some impatience is expressed at Sir Hercules Robinson's disinclination to press the acquisition of the Delagoa Bay Railroad.

The Kimberly diamond mines will come of age next year, and it is proposed to celebrate the occasion by an exhibition. In the mean time the proposed annexation of Bechuanaland and the extension of British protection to the Zambesi promises to make Kimberly a station on the principal trade route from the Capes to Central Africa, and the business men of that city are paying a great deal of attention to the selection of proper representatives to the colonial legislature, at Cape Town, in hopes of hurrying railroad construction northward. Materials have been ordered in England for the extension of the railroads from Kimberley, the present northern terminus across the Vaal River to Bechuanaland. A further extension through the latter region is under survey.

### Continuous Brakes in England.

A British Board of Trade return shows that on June 30 last 51 per cent —an advance of 3.5 per cent. since the last return—of engines and tenders in the United Kingdom were fitted with continuous brakes, while the proportion of passenger cars fitted was 76 per cent., an advance of 5 per cent. The mileage run by trains fitted with these brakes is 66,053,727, or 89 per cent. of the whole passenger train mileage. The trains running without continuous brakes are chiefly short trains on small branches. The brakes chiefly used are the automatic vacuum and the Westinghouse automatic.

### Relief Organization on the Philadelphia & Reading.

A dispatch from Reading, Pa., Oct. 30, says: Nearly 300 delegates, representing the 25,000 employés of the Reading Railroad in every branch of the service from all cities and towns along the main line and branches, met here to-day to act on President Corbin's scheme to create a relief association for the company's employés. There was a free discussion of the proposed insurance plan. Of sixty sections in the plan about two-thirds were unanimously adopted. The objections to the remainidg sections were received and recorded for the purpose of referring them to a committee for action. The claim was made that the dues were unusually high and the benefits not in proportion. Employés are to pay from 75 cents to $3.75 per month according to their salaries, and will receive in case of sickness or disability from 40 cents to $2.50 per day, according to salary. The plan was finally adopted by a vote of 129 to 80. It is to go into operation on Jan. 1.

### A Wonderful Run.

It is claimed that an *Inter-Ocean* special train over the Louisville, New Albany & Chicago ran from Rensselaer to Monon making an intermediate stop, in incredible time. The report in the office of the train dispatcher showed that the special made the 16 miles in 15 minutes, and that included in the 15 minutes was a stop made to take coal. The usual time required to take coal is about three minutes on an ordinary passenger train stop. On the special, Engineer Klein stopped No. 21 exactly under the chute, and before the wheels had ceased revolving the rope was pulled. The train was again in motion, and the bottom of the chute nearly struck the top of the car as it went back to its place, though it is said that no coal was wasted.

### There is Nothing New.

"Cable cars are quite a recent thing in transportation," remarked the casual caller. "Not at all," replied the snake editor. "We read about them in the Bible." "What!" "Yes, you will remember that Paul stood before a gripper." —*Pittsburgh Chronicle.*

### Of Interest to Investors.

Our inquirer, C. W. W., who desires to know the "longest bond on the market, which will not be called in too precipitately," is respectfully informed that the Elmira & Williamsport Railroad 5s fall due A. D. 2862, which will probably be a long enough bond to satisfy the reasonable desires of an investor desiring permanency.—*Philadelphia Public Ledger*

RAILROAD GAZETTE

Published Every Friday,
At 73 Broadway, New York.

## EDITORIAL ANNOUNCEMENTS.

**Contributions.**—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

**Advertisements.**—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

The contest between the railroads and the state authorities in Iowa has assumed a new development in connection with a request for returns of "value of road." Most of the railroads make the perfectly truthful statement that they cannot tell. The value of a road is determined by its earning power, present and prospective. As far as it can be determined at all it is determined by the market price of the securities; but under present circumstances this is of course very uncertain. The Rock Island has made this statement and something more. It has said distinctly that the value of the road is less than it was four years ago, and that if matters continue in their present course it will be still less four years hence, the action of the state authorities having been such as to cause great depreciation in railroad property. This is a perfectly fair statement of the case, but we fear that it will have very little effect upon those to whom it is addressed. The fever for legislative control is not taking precisely the same form that it did in 1873 and 1874, but it is almost as intense, and there is real danger that nothing short of disastrous experience like that of 1875 will serve to check it.

Instruction as to what *not* to do is an important part of any teaching process, and indeed is often deemed of the first importance, if we may judge from the fact that it is attended to before the positive teaching is attempted. It serves to clear the ground, like the demolition of an old building preparatory to erecting a new structure. But in railroad instruction this principle is often neglected, perhaps on the assumption that the ground is sure to be always well prepared, and thus never in need of clearing. If the men at Mud Run had been told *not* to exhibit both clear and danger signals at the same time and place they perhaps would have come out clear. The duties of many men in many places can be much more surely impressed upon them by telling them when they must *not* desert their posts, telling of things (which they are liable to do) that must *not* be done at certain places, etc. In fact, the truth is so self-evident that it seems a waste of time to state it; and yet train-rule codes show many instances where it is ignored, though every superintendent recognizes it in his oral communications to his men. These thoughts are suggested by the illustrations of Wabash signals shown on another page of this paper. Mr. Wade's excellent prints of tender signals at once bring to mind the numerous instances, to be seen on many roads, of the inclination of engineers to carry signals on the tender when they should carry none whatever in that position. After a runner has made a trip empty he often seems to be impressed with a firm conviction that he is to make another similar trip very soon, and that it would be a tremendous waste of labor to take in the tail signals and then have to display them again. Hence we see numerous passenger trains with tail signals in two places. It is of course very unlikely that any such train will break in two immediately behind the tender, and the deceptive tail signals thus become dangerous; but exact habits as to what signals *shall* be carried can best be inculcated by maintaining at the same time strict rules as to what shall not be carried. The direction not to needlessly exhibit a red signal is perhaps violated by engineers as often as by any other class. An unmeaning red flag on the tender may do no more harm than would a dirty slouch hat on the conductor's head, but both are badly out of place. We therefore suggest to Mr. Wade the use of a cut showing a tender without a signal as a means of instructing engineers what to do when running forward and hauling a train!

The letter in another column, on distant signals, and the lesson of the Mud Run disaster concerning them, is of especial note as coming from a careful officer, who has had extensive experience with the signals he writes about. Mr. Blodgett doubtless has in mind the track-circuit system, which his road, the Boston & Albany, has in operation at a large number of stations on its main line, as well as to some extent elsewhere. The *Railroad Gazette* has often shown the value and advantage of a distant signal at stations. Automatic signals, although they cannot be used (at least in any but a very limited way) as an "absolute block" system, can, and do, when combined with proper train regulations, afford very great additional protection. They have a great advantage over one to be pulled by hand, in that with the latter a man may forget to set the signal to danger at a critical time, as was claimed in the case of a rear collision of passenger trains on a trunk line last winter. The automatic signal never sleeps, never is drunk, and never forgets. When properly taken care of it may be depended on to work with almost absolute certainty. One great advantage in its use is that the engineman always knows where to look for the danger signal, and of what character it will be. Its tendency is also to eliminate rashness in train running, by giving men less frequent opportunity to assume that things must be all right because they do not see a flagman or notice to the contrary. These signals may be made in most instances to conform to one of the most important principles of the block system, viz., that danger must be presumed to exist unless the contrary is unequivocally shown. This requires that the force producing the clear signal should be constantly operative, and that any failure from whatever cause should make it show danger. Trains must thus run by a system of *safety* signals instead of *danger* signals. It also requires that each engineman should see the signal operate *for his train*, and in the event of failure or derangement of any kind proceed through the section with caution and only as the way is known to be clear. Automatic signals may thus, without the great expense of the block system, fulfill one of its most important functions with almost equal reliabilty. It is but fair to remember, though, that the track-circuit station-signal, as generally operated, has a weak point in its mixed character of a home and distant signal combined. A first principle of distant signals is to have a definite distance between the signal and the fouling point. A home signal should be exactly *at* the fouling point. The location of the signals is sometimes such as to lead to confusion in the train-men's minds on these points.

The defense of the Lehigh Valley would probably be that Mud Run was not an obscure station, there being a good view, notwithstanding the curve, and that available funds should be spent elsewhere first. The *principle* of a distant signal was observed, as we stated last week, in ordering the train to pull some distance beyond the signal; but the distance prescribed was not enough.

It is generally assumed by the daily newspapers that the ignorance and loose habits uncovered at Mud Run must in the nature of things exist among other employés; that a mere coincidence could not produce such concurrent blundering under an efficient system. Is this true? Unfortunately there are significant facts which combine to indicate that many employés on many roads could testify that it is. In the nature of things, the cases where one careful person neutralizes the carelessness of one or more others are not generally heard of; but they happen nevertheless. It is asserted on good authority that more than one passenger engineer on a certain prominent line will be found unable to read and write with anything like decent proficiency. Is it not likely that these men are kept out of trouble by friendly firemen or conductors? And yet the manager is supposed to have two good men, instead of only one, on each engine. On another road a fast passenger train is run by an engineer who is so near-sighted that only by the most constant vigilance can he see signals even a moderate distance ahead. How much margin of safety is there in *him*? A road whose passenger mileage is counted by tens of millions, and whose line runs through one of the most thickly settled states, still uses a set of train rules that, to judge from a dozen of the most important ones, must embody nine-tenths of all the bad features that the makers of the uniform code threw overboard in the course of their work. Does any one suppose that anything but the vigilance of the older men prevents the younger ones from making fatal blunders under such contradictory instructions? A conscientious freight conductor recently explained the fact that engineers fail to see danger signals, by the assertion that "they are too lazy to look out of the front cab window. * * I have from the top of the forward car seen a red flag some time before the runner espied it, and when it was in full view from his seat." This strong language is no doubt justifiable oftener than those affected would like to admit. Every month or two a collision occurs from the stopping of some engineer's watch. Is it supposable that we hear of all such faulty watches and of all the shiftless engineers who start from stations without knowing that both their own and the conductor's watches justify starting? No; for the careful men act as a check on the careless. Admitting that a certain percentage of careless ones will always be with us, the question is, can the public be convinced that this percentage is not far too large?

The above strongly emphasizes the responsibility of railroad owners, or those who control the owners' money. But while the employer is thus bound to provide good mechanical apparatus and to seek the best available men to operate them, the principles of law, mentioned in the letter alluded to above, condemn employés as severely as they do the proprietor. Where there is contributory negligence the law allows both parties to suffer. So far as legal penalty is concerned, each man who might have prevented the Mud Run disaster is held to the very letter of his instructions; and is he not held, morally, for considerably more than that? Some flagmen go back further than the number of feet specified in the rules. They would say, "This is not a regular runner to-night; besides he has been on duty for a long day; I will favor him instead of myself." Some station agents would have seen the possibility of the runner being deceived by the all-clear signal, and have reminded the brakeman to go back further. Many engineers would put forth extra exertions in circumstances like those which Cook and Major found themselves in on approaching Mud Run, and would have looked for themselves, notwithstanding an extra lookout man was furnished. If we had not a good many such runners we should have twice as many collisions as we do. A cautious conductor would put himself out to get the ticket-taking done so as to have his mind free at the most critical points. Many a veteran conductor could doubtless tell of instances where his presence in the forward end of the train has been the means of making a quick stop, which obviated a collision. Superintendents who have risen from the ranks by merit rose because they had this kind of merit. Conductors, engineers, station agents or brakemen who expect to rise in the future must have this spirit. And it is their moral duty to have it whether they rise or not. It is generally assumed that men may be depended upon to be sufficiently vigilant where their own lives are at stake; and even superintendents share this feeling, though facts proving the weakness of the theory are so plentiful. There is, however, a motive higher than that of mere selfish regard for one's own bodily safety, and that is the feeling of responsibility for the lives of others. A superintendent is almost compelled to give pecuniary considerations the paramount claim. The evils for which he shares the responsibility can be cured only by joint and concurrent action of several persons. Any amount of individual effort may prove of no avail. But the engineer or flagman is not thus hampered. He can do more than his duty, and for humanity's sake often should do so. How paltry the arguments tending to throw blame for a slaughter upon a fellow employé, when the fact that we might by a little effort have relieved him from his now wretched situation stands forth so clearly!

### Rails and Wheels.

The committee of the American Society of Civil Engineers to which was assigned the duty of investigating the obscure and important subject of the relations of rail and wheel sections has made a preliminary report which is just published in the *Transactions*

of the Society. Some of the material presented in this report has been before published, but the statistical tables are mostly new and are of great value in their bearing upon the subject. On another page we reprint some of the most important compilations which the committee has made from the statistics which it has gathered, together with some of suggestions of the committee.

Although this is but a preliminary report, printed for information and discussion; and although the committee explicitly refrains from drawing any conclusion now, its conclusions are probably pretty clearly foreshadowed so far as regards the question of rail corner and flange fillet. It is highly unlikely that evidence to be collected hereafter will do more than confirm the plain deductions from that now presented concerning the relative importance of flange wear as an element in the life of wheels, or concerning the effect on flange wear of the form of the rail head. Nevertheless, those who have given most attention to the question will best realize the force of Mr. Barr's statement that it should be thoroughly and practically investigated, "for theoretical investigation is liable to error on account of the difficulty of assigning the proper value to each of the many circumstances that affect the result." The committee, therefore, in this preliminary report states the question, presents the evidence and awaits further information.

The question as the committee understands it is (1) whether it is preferable that the sections of the rail and wheel should be so designed that the radius of the fillet of the wheel flange is longer than that of the corner of the rail, or (2) whether it is preferable to make the head of the rail and the tread and the flange of the wheel of such section that they shall be normally in contact with each other from about the middle of the rail head over the rail corner and down to a point where the curves in the flange reverse.

The advocates of the second form of design claim that by making a fit between the rail corner and flange fillet greater bearing surface is secured, and hence less rapid wear both of wheel and rail. The advocates of the first form claim that by making the fillet radius comparatively large and the corner radius considerably smaller the wear is less rapid, for the reason that the friction between the wheel and rail is chiefly rolling friction in that form, while by extending the surfaces in contact down the side of the rail rubbing friction is introduced. They claim further that the importance of flange wear as an element in shortening the life of wheels has been greatly exaggerated, and that even if this were not true, there is no good evidence that rail corners of small radius tend to increase the cutting out of flanges. Another result of the less friction in the first type of design, that in which the surfaces are in rolling contact only, would naturally be less train resistance. There are other claims made on both sides, as to the greater or less danger of derailment, etc., but those stated above are the most important.

The committee reviews the history of the discussion through which this question gradually took the shape in which it is now presented. With that our readers are familiar, but it is well to recapitulate briefly.

Attention was particularly called to this matter by a report made by a committee of the Master Car-Builders' Association, in 1883, in which the committee expressed the opinion that by far the greatest cause of sharp flanges was found in the sharp corners of the rails, and recommended that rails be made with a ⅝-in. radius, so as to exactly fit the flange. This report was not acted upon by the Association, but in the convention of 1884, Mr. Forney, Secretary of the Association, presented an elaborate paper, sustaining the theory laid down by the committee of the previous year.

The Lehigh Valley Railroad had already adopted what is now its standard rail section, designed by Mr. Robert H. Sayre, Second Vice-President and Chief Engineer. Mr. Sayre holds that the sharp cornered rail attacks the wheel in its most valuable part, and that, while the rail is being worn down to conform to the normal shape of the wheel, the wheel, which costs more per ton than the rail, is being ruined by cutting through the chill and wearing the flange straight. Mr. Sayre cites records of the Pennsylvania Railroad for a period of five years, while a sharp cornered rail was in use, showing that 40 per cent. of their wheels removed were worn through the chill in the throat, or had straight flanges, whereas a record of three years on the Lehigh Valley showed that but 4 per cent. of wheels were removed for these causes. The committee corrects this latter assumption at once by the statement that it is founded on an entire misapprehension. The percentage of *worn out* wheels on the Pennsylvania is compared with the percentage of *all* wheels on the Lehigh Valley. The correct figures, which appear in this report, and which have never been printed before, or even collected in manuscript, show that the Lehigh Valley percentage is not now, and never has been, lower than that of the Pennsylvania, and apparently the percentage of sharp flanges has increased since the adoption of the round-cornered sections.

The discussion was carried on in the columns of the *Railroad Gazette* in 1885, in a communication from Mr. A. M. Wellington controverting the theories of Mr. Forney, and in letters from others, particularly one from Mr J. N. Barr, Superintendent of Motive Power Chicago, Milwaukee & St. Paul, going to show that two sharp flanges occur rarely on the same axle, in the first run of the wheels, and inferentially sustaining the argument that the shape of the rail head has little if anything to do with sharp flanges.

The committee does not mention an earlier, and quite elaborate, theoretical discussion of this same subject which was reprinted in the *Railroad Gazette* April 6, 1883, from *The Engineer* (London). In that article was given the substance of a study made by Herr Wöhler in 1881. Herr Wöhler recommended a fillet radius of 1.1 in. for a rail head having a corner radius of 0.55 in., his theory being that with this long fillet radius the wheel would be driven away from the rail before the flange came in contact with it. The writer in *The Engineer* reasoned theoretically that it would be impossible to keep the flange away from the rail, and recommended a fillet radius but a trifle greater than the radius of the rail head in order that the two curves might soon be worn to a fit. He carried the curve of the fillet down but a short distance on the flange, however, and followed with a tangent of about three-quarters of an inch, inclined at an angle of 55 deg. to the horizontal. His aim was to make the surfaces in contact as large as possible, but at the same time to get a flange that could be re-turned with the minimum loss of material. At the same time he avoided the rubbing friction consequent upon prolonging the contact down the side of the rail. Herr Wöhler's position was essentially that of the later writers who have favored the sharp rail corner and large fillet radius, in that he aimed to make all friction between the rail and the wheel, rolling friction. The *Engineer* aimed, as do those who now favor nearly identical radii for the rail corner and flange fillet, to secure large surfaces in contact as the wheel runs up on the rail corner, as on the outside of a curve; but he did also to a great degree keep the flange from rubbing against the side of the rail. It will be seen that in this earlier discussion many of the arguments from theory of the later disputants in this country were anticipated; but until now the arguments on both sides have been mostly from theory. Mr. Forney based his conclusion that the radii of rail and fillet should correspond, on the argument that, as the maximum weight carried by car wheels is now from 5,000 to 8,000 lbs. the bearing surface must be subjected to pressures of from 40,000 to 64,000 lbs. per sq. in., and to get greater bearing surface to resist wear he would increase the areas in contact. "In other words, the treads and flanges of wheels should be made of the same shape as the heads of the rails." And this is practically the whole argument of those who favor what we have called the second type of design. That is, they treat the wear of wheels, in the fillet and flange, as a serious element in the destruction of wheels, and they claim that this wear will be reduced by making the curves of wheel and rail conform, so as to get a large surface in contact in the throat of the wheel.

The committee of the American Society has collected a large body of statistics, which show very conclusively what part flange wear plays in the economy of wheels. It is shown from the records of seven roads that, in passenger service, the wheels removed for worn flanges are from 2 75 to 12.2 per cent. of *all* removed, and in freight service they are from 2.97 to 21.5 per cent. From the records of the Pennsylvania wheels in passenger service it appears that of all wheels *worn out* from 26.63 to 36.72 per cent. were removed for worn flanges. These figures taken alone would give a wrong notion of the importance of this element of wear. From the mileage figures it appears that of wheels removed worn out, those removed for sharp flanges had made greater mileage than those removed for any other cause, except those classed as "hollow from flange." This is from the records of the Pennsylvania for ten years. The records of the C., B. & Q. for all classes of wheels for two years show a better mileage record for sharp-flanged wheels than for "all others." The records of the Pennsylvania Company give the mileage of sharp-flange wheels in passenger service as 77,809 miles, against 81,460 miles average for all wheels worn out. On the Lake Shore the mileage for passenger, locomotive and tender cast wheels was 53,572 miles for sharp flanges, against 56,585 miles made by wheels removed for all other causes.

These figures show clearly that it is not of paramount importance to make the sections of rail and wheel such as will give the least wear in the throat of the wheel; that is, that other important considerations should not be sacrificed to this end. If, however, this end is of paramount importance, can it be attained by using a large corner radius for the rail and making it fit the fillet? So far as the statistics presented in this report go they apparently show that it cannot. It is seen that the percentage of flange worn wheels on the Pennsylvania has been greater since 1884, when the rail radius was increased and the fillet radius diminished, than it was before that year. It is seen also that the mileage made by flange worn wheels has averaged less since 1884 than before. The percentage of flange worn wheels drawn in 1887 is larger than ever before, and the mileage made by them is less than the average of the preceding nine years, although greater than in the preceding three years. This apparent increase in flange wear may perhaps be accounted for by closer inspection, or by changes in other conditions. If, however, it shows anything for the relations of rails and wheels, it shows that the round corner is more destructive to the wheel than the corner of shorter radius. Comparison of the records of different roads, one with another, knowing the rail and wheel sections of each, would be of little value for the purpose under consideration without far more data than are brought forward in this report. The systems of inspection, classification and record, the conditions of service, and the make and metal of wheels, are so different on different roads that such comparisons would be difficult to make, if not positively misleading. This is true to a less degree of any comparisons of the records on any one road for different periods. We have not, therefore, the means of knowing just what sections of rail and wheel have together given the best service, but from the data now presented the obvious inferences are that the rail and wheel should not fit each other in the curve of the throat of the wheel, and that the corner radius should be less, rather than greater, than the recent standards.

## The Economy of High Pressure Steam.

The relative efficiency of high and low pressure steam has only recently been tested on a large scale, for though very high pressures have been used experimentally for many years, it is only recently that gradual progress in the mechanical details of steam engines and a clearer conception of the principles of compounding have enabled engineers to avail themselves largely of high pressure steam. While the use of pressures above 150 lbs. per sq. in. has been mostly confined to triple expansion marine engines, it has also been very successfully used in both compound and simple locomotives. In this country, Mr. G. W. Stevens on the Lake Shore, and Mr. J. N. Lauder on the Old Colony, are running the principal express trains on their roads with boiler pressures of 180 and 175 lbs. per sq. in., respectively. Mr. Webb, in England, is using the latter pressure on his compounds, and pressures of from 160 to 180 lbs. per sq. in. are used in the compound locomotives that are fast coming into more general use in France, Germany, Russia, India and other countries.

Even higher pressures have been used on locomotives as far back as 25 years ago, but it does not appear that the practice was continued. The probabilities are the strength of the boilers of that date and the arrangements for lubrication were insufficient to stand pressures of 200 to 220 lbs. per sq. in., and that greater heat of the high pressure steam caused excessive wear of the valves and pistons, as the continuous lubrication of the present day was then unknown. At the present time a pressure of 180 lbs. per sq. in. appears to be the highest in regular and extensive use on either locomotives or marine engines.

The fact that the economy of very high pressure steam has surpassed expectation has been abundantly shown in many instances. The general explanation has been that the improved mechanical construction of the engine and the more equal pressure on the working parts throughout the revolution diminished the internal friction of the engine and so conduced to economy. While these factors have undoubtedly done much to diminish the amount of energy wasted in even the most economical steam engines, it is difficult to believe that the unexpected superior economy

of high pressure steam can be wholly thus explained. The fact that steam condenses on entering a cylinder and that the condensation is re-evaporated when the pressure falls during expansion has long been known, but the bearing on economy has only become widely appreciated during the last few years. The exact nature of the changes which take place in the heat energy of the steam in the cylinder are still, however, imperfectly understood and are the subject of much debate.

Mr. Worby Beaumont, in a paper printed on another page, gives a further and hardly suspected explanation of the cause of the superior economy of high pressure steam. Mr. Beaumont's paper will repay the careful examination of those who are interested in the question and his belief in the further economy to be gained by still higher pressures will encourage those who are experimenting in that direction. Hitherto, it has been believed that any further increase of pressure could only hold forth the prospect of a slight theoretical economy, while the practical disadvantages were obvious. Engineers, however, are daily becoming better able to build engines and boilers that can overcome the difficulties of using very high pressure steam, and any well-founded anticipation of further economy will doubtless do much to extend the use of high pressures.

It must, however, not be forgotten that recent practice points strongly to the advisability of utilizing the expansion of high pressure steam in a series of cylinders. It would certainly appear that this experience as to the advantages of compounding has been also found to exist in locomotives. As has been previously pointed out in these columns, the application of the compound system to locomotives has an additional source of economy as compared with most forms of steam engines.

A compound locomotive may be expected, like other engines, to be more economical than a simple locomotive when working at the same grade of expansion. The greater portion of the superior economy of a compound locomotive is, however, due to the fact that when exerting its full power it is working with a threefold expansion, whereas the ordinary locomotive is working with the steam on for nearly the whole stroke, and consequently with an insignificant amount of expansion. When a compound locomotive is being worked to its utmost capacity, the cut-off in the high pressure cylinder may be at 75 per cent. or later in the stroke, but the steam subsequently expands in the low-pressure cylinder, and consequently the total expansion is about threefold, when the capacities of the high and low pressure cylinders are as usual about 1 to 2.3. The compound locomotive when working with this minimum amount of expansion consumes but little more steam per unit of power than an ordinary locomotive when working with its maximum amount of expansion, say when cutting at about 5 or 6 in. of the stroke. Hence it is not surprising that the economy of compound locomotives has been most conspicuous in working trains making frequent stops where the engine is constantly exerting its full power in starting. Unfortunately, there has been some difficulty in starting compound locomotives, but this difficulty has been overcome, and probably within the next few years compound locomotives will be largely used.

The practical objections against the use of high pressures are fast disappearing. It is now recognized that the boilers must be well designed and carefully made of stout plates, the longitudinal seams being double riveted butt joints kept above the water line, and care being taken that the method of staying is sufficient for strength, and creates no local bending action under pressure with its inevitable tendency to cause furrows, a fertile source of explosions. The use of balanced slide valves, metallic rod-packing and continuous lubrication prevents any cutting of the internal working parts.

The objections against the use of high pressure steam being thus removed, it seems probable that within the next few years a considerable development will take place in the use of high pressure compound locomotives. The consequent economy of steam will enable the boiler to be fired more economically. The size of a locomotive boiler is limited by considerations of size and weight, and at present locomotive boilers have to be forced to produce a maximum amount of steam by a sharp blast. A large amount of fuel is wasted in this forcing process, and there can be little doubt that the same boiler could be fired more economically were a less amount of steam required. In other words, an enlargement of the blast pipe would permit a more perfect combustion, and 1 lb. of coal would evaporate 8 or 9 lbs. of water, instead of 5½ to 7 lbs. as at present.

The gain from the use of higher pressures and compounding would be therefore twofold. Not only may we expect that one pound of steam will do more work, but it may also be anticipated that the pound of steam can be produced by two instead of three ounces of coal.

## Transcontinental Rates.

During the first period of the operation of the Interstate Commerce law, the transcontinental tariffs were not made to conform to the short-haul clause. The competition of the Canadian Pacific, and the less direct competition of the ocean steamship routes, seemed to exempt the Pacific roads from the operation of the act; while the lack of financial prosperity on the part of several of them made it less easy for the Commission to demand rapid compliance. But the Commission was not disposed to allow this state of things to remain without protest. In its report to Congress a year ago it called attention to the fact that the state of affairs on the Pacific roads could only be regarded as temporary. In the decision in the case of Martin vs. Southern Pacific, filed May 17, 1888, the question of transcontinental rates was taken up on broad grounds, and it was clearly indicated that the existing system would not be allowed to continue. On September 1, 1888, the transcontinental lines adopted a new schedule of rates which was intended to conform more nearly to the requirements of that decision. This was the easier for them to do, because the Canadian Pacific had meantime come into an arrangement, whereby, in consideration of a moderate differential allowance, its irresponsible rate-cutting was largely abandoned. The September tariff made a radical change in freight classification. It discarded the Pacific Coast classification, both east and west bound, adopting the western classification as far as class rates themselves are concerned, and supplementing it by a series of commodity tariffs. The general range of changes is illustrated by a selection from Tariff No. 10:

| Between Pacific Coast common points and | First Class. | Fifth Class. | Class E. |
|---|---|---|---|
| Missouri River common points; also St. Paul and Minneapolis Minn., and Galveston and Houston, Tex. | 3.50 | 1.75 | 1.00 |
| Mississippi River common points, Dubuque, Ia., to New Orleans, La., inclusive | 3.70 | 1.80 | 1.05 |
| Chicago, Milwaukee and common points | 3.90 | 1.85 | 1.10 |
| Detroit, Toledo and common points | 3.95 | 1.90 | 1.15 |
| Buffalo, Pittsburgh and common points, and points east thereof and west of Atlantic seaboard common points | 4.00 | 1.95 | 1.15 |

This is supplemented by special east-bound rates upon some fifty or sixty commodities.

It will be observed that this tariff did not touch Atlantic points. These were governed by Tariff Sheets 8 and 9, and were made somewhat less than intermediate rates. The violation of the short-haul principle was justified by the existence of ocean competition. Unfortunately this low seaboard tariff bore heavily on the business of certain interior points not thus favored. To meet this difficulty a set of supplementary tariffs was issued, naming special commodity rates from a number of local points on west-bound business to the Pacific Coast. As may be imagined, this threw the whole matter into great confusion; three different systems, if the third can be called a system, coming into contact, and often into conflict.

Commissioner Walker in an opinion just published gives curious instances of want of relation between the sets of tariffs, which sometimes favor the seaboard, sometimes the interior points. But the radical objection to the whole matter was the arbitrary way in which commodity rates were named in Tariff Sheets 11–16 from certain points and not from others. Where, as was frequently the case, there was a great difference between the commodity rate and the class rate, it resulted in an arbitrary discrimination between two points almost adjoining. Commissioner Walker is right in condemning the results of this policy as violating the spirit of the Inter-state Commerce law. We are glad to see that the Transcontinental Association has suspended Tariffs No. 11–16, which will go far toward making a thorough reform possible. The matter now stands in this shape: Tariff No. 10, from which we have given the extracts, based on the Western classification, operates as a maximum in both directions. East-bound rates to Atlantic points, subject as they are to a water competition, are determined by a series of commodity tariffs in Sheet No. 9. West-bound commodity rates from the seaboard are given in Tariff No. 8, but in west-bound business the short-haul principle is to be applied, so that all interior points, as well as seaboard ones, can have commodity rates west-bound on these articles.

The next step in the process, and one which we have no doubt will soon be taken, should be the abandonment of the commodity rates in Tariff No. 10. At present it is not easy to determine which set of commodity rates an article takes. On west-bound business there would, under existing circumstances, be no difficulty whatever in throwing the whole system of commodity rates into one tariff, the short-haul principle having been already fully recognized in this direction. On east-bound business it would involve less confusion to have one tariff of commodity rates, even if those for seaboard and interior points were arranged on a somewhat different basis, than to have such rates divided into two tariffs and mixed up, as they now are, with the class rates in opposite directions.

## Demurrage.

We print in this issue the circular of the Southern Railway & Steamship Association announcing a system of terminal charges prepared by the Rate Committee of that association to go into effect Nov. 1. The Chicago roads have taken similar action, as announced in our last issue, so that we shall have two quite extensive experiments in this line whose workings will be watched with interest. The Southern Association proposes to charge only 50 cents a day, one-half the minimum prescribed in the Chicago agreement, and also will collect on goods in freight houses as well as in rolling storehouses. Both agreements seem to provide for competitive points only, though it seems likely that the Southern roads, at least, will put the rules in force at non-competitive points also.

Both of the best-known movements heretofore inaugurated seem to owe much of their success to discreet management. The Omaha bureau is confined to a limited and well defined locality, and the palpable saving in money has doubtless been large enough to inspire the superintendents with the courage necessary to resist appeals for relaxation of rules. The New York & New England management has pursued a conciliatory and moderate course with its patrons and has taken a time when local business is heavy enough to remove many of the temptations to pursue a vacillating course. The volume of business at Omaha is also doubtless large enough to keep the facilities utilized. The encouraging degree of success in these instances must, therefore, not be taken too readily as a guarantee of success everywhere and for all times. The provision of the Southern agreement for forcing unwilling consignees to pay, and that of the Chicago rules against holding back cars consigned to overcrowded tracks, suggest doubtful features which, with other well-known weak points, constitute elements which every one knows must be guarded against. Mr. Fink says there is no form of rate agreement that can not be evaded, and the same is probably true of other questions than transportation rates. Unless there can be more good faith and more agreement of views as to what constitutes good faith than is generally the case at points where competition is sharp, the life of these agreements will be short. The collection of storage on small shipments and at small stations will be accompanied by all the difficulties attending demurrage, and others besides; adherence to a uniform schedule will be difficult to enforce, and the chance for personal favoritism and dishonesty will be great. If storage, trackage or any similar charge is collected at one place and not at another, the law against discrimination will be invoked by consignees sooner or later.

One general manager recently asserted that favoring consignees by giving the use of cars for storehouses was a worse evil than rate-cutting. It certainly is worse in one respect, the greater facility with which discriminations can be concealed and the difficulty of making exact comparisons between the concessions accorded by different roads.

Of course when a yard or delivery track is partially empty or idle, the temptation to use that track-space as an inducement to secure trade may be just as strong as it would be if the agent possessed of money with which to treat possible customers to cigars or furnish them with free tickets. Whether any plan can be devised by which cars will be charged for when they are worth nothing to the owner, the same as when he can make a profit of $5 a day on every car he can get hold of, remains to be seen. In sleeping-car rates, stock-yard charges and some other things, unreasonable competition has been avoided thus far, the separate control and ownership being probably a main reason for this. Storage charges, where goods have been placed in outside or public store houses, have also been maintained at remunerative rates; but to place freight yards or yard work in the hands of outside parties is probably

entirely impracticable. A variable rate for demurrage is perhaps one of the possibilities of the future. With a smooth-working organization and a perfect system of telegraphic communication, it might be possible to vary the price for the use of a car somewhat according to the demand for it.

Uncertainty as to what constitutes a reasonable price for the use of cars, was a main feature of the discussion at the Time Convention, it will be remembered. Fluctuations in the value both of cars and of the ground they stand on are inevitable and cannot be measured with any accuracy, but so long as courts and lawyers continue to look upon cost of service as the true basis on which to calculate charges, or so long as railroad men think they thus view the matter, facts concerning the elements of cost will not be wholly without interest. Cost figures will answer for a starting point, if nothing more; and if we can clearly establish the cost at one place at any one time we shall be better prepared to show the higher value of the service at other times and to estimate the amount of loss incurred when valuable service is sold at too low a rate or given away.

Three principal items enter into the terminal charge on a carload of bulk freight; the rental value of the land occupied, the interest on the cost of the car, and the labor and expense of switching. Other elements may be omitted, as the calculations can be only approximations at best. Land in cities is worth from $1,000 to $75,000 and more per acre. Yards that cost $25,000 and upwards are common, and in the case of one we have now in mind adjoining lots are held at over $60,000 per acre. Allowing a moderate share of space for the use of drays we may roughly estimate the number of cars that can be placed upon an acre of ground for unloading at 50. Estimating the land, with tracks upon it, at $50,000 and the rental value at 8 per cent per annum we have $4,000 per year and $80 per year per car, or, say 25 cents a day. The interest on the car may be placed at 15 cents, in accordance with the well-known conclusions of the Car Accounts' Committee. The cost of switching may be estimated by assuming a delivery yard with a capacity of 150 cars, which would keep a switching crew fairly busy for 10 hours. If the expense of this engine and crew were $30 per day, each one of 150 cars should be charged 20 cents. We thus have land 25, car 15, switching 20, total 60 cents. But all this is on the assumption that business is always good, tracks always filled, and switching engine busy the year round. Business is, however, sometimes dull, tracks are empty and men idle. Interest, taxes and wages go on then the same as ever, and must be paid. The dullest judge in the land cannot deny that a dry goods dealer must make enough profit on his heavy Saturday sales to help pay the wages of the clerks on dull Mondays. The principle is just the same here and has to be recognized everywhere.

Taking this into consideration the just price to be charged the consignee may well be much greater than we have figured it. It would probably be nearer $1.20 than $0.60 in many cases. The value of land of course falls off as we go from city to country, and at a small station handling a few cars a week may almost be ignored in the computation. But the other items are as important at one place as another. When cars are in demand, those standing at Screech Owl Siding are wanted as badly as those immediately under the elevator. It is as fair for consignees at such small places to pay an amount somewhere near that charged to city customers as it is for passengers in level country to pay part of the expense of hauling other passenger for five cents over two miles of mountain road whichcost a quarter of a million dollars to build.

While, therefore, the presentation of figures showing the cost of some of the items which the public are asked to pay should do no harm, the limitations surrounding them should be stated with equal clearness. In dealing with men who insist on considering cost as the main basis, a free admission of the element of truth in their theories at the outset is the best way to advance true ideas. The latter are strong enough to sustain themselves in spite of the former. In fact, they can be built upon them as a foundation and be all the firmer in consequence. It costs a good deal to build, handle and store cars, whatever the amount of business done with them. It costs a good deal more to get along without them when business is offering and shippers are complaining that the scarcity of cars cripples their sales of goods.

## The Illinois Central and the Standard Oil Cases.

In the decision of the Inter-state Commerce Commission in the Standard Oil cases six months ago, the management of the Illinois Central Railroad (among others) was severely criticised. Its agents were charged with making discriminations in favor of tank-car shipments to New Orleans, and concealing the fact from Geo. Rice. On shipments to intermediate stations, actual weight was charged, whether the oil was shipped in tanks or in barrels. On New Orleans shipments, the loaded tank-car was charged at a 24,000-lb. rate, even if it contained 40,000 lbs. The Commission strongly implies, if it does not actually say, that this was due to bad faith on the part of the company.

A letter of Mr. E. T. Jeffery, the General Manager of the Illinois Central, which was sent to the Commission last April, but has only just been made public, indicates that serious injustice has been done to the company. In the first place, the quantity of business involved was a mere trifle, which any management might perfectly well overlook unless it was specially brought to their attention. Between April 5 and Nov. 1, 1887, the period covered by the complaint, only five tank cars of oil were carried by the Illinois Central for the Standard. These were shipments from Cincinnati to New Orleans. In accepting such business, the company naturally conformed to the practice in use on the line of initial rail shipment, especially since that was the universal and almost unquestioned rule on lines lying farther to the south which handle more of this traffic. To blame the general management because it overlooked these five carloads, or because it did not know the way in which mileage was credited, seems to us most unjust. The strictures of the Commission certainly imply that the company did much business of this kind; for the decision alludes to tank-car mileage as an "important subject" for the general freight agent to have in mind. The actual facts of the case make the criticism almost pointless.

The only formal order with which the Illinois Central Co. has been served is that made in the case of Geo. Rice v. Newport News & Mississippi Valley. But, in point of fact, there is no evidence whatever that the Illinois Central either made joint rates with that road or handled any through traffic in connection with it. The Illinois Central seems to have been arbitrarily brought into the case. The responsibility of the Commission for this error is all the heavier because the company refused to make a joint defense with other railroads involved in these cases. Before treating the different complaints as one, the Commission was in duty bound to see that there were facts which warranted it in so doing. The absence of such facts puts the Commission in the wrong.

But this is not the most objectionable point in the whole decision. In charging the company with bad faith, the Commissioners quote a letter from the general freight agent of the company to the complainant. They imply that this letter is quoted in full. They also add that nothing in the letter could so restrict it as to prevent its application to New Orleans business. But it now appears that the letter was not quoted in full: and that the part which was omitted might fairly be taken as restricting the application of the rest. We give the most essential part of the letter, correcting an unimportant clerical error in the Commission's citation, and italicising the sentence which they omitted. "*Our local rates changed on the 1st inst.* Coal oil or its products, in barrels, is now third class; if released, sixth class. In tank cars, released, sixth class, actual weight to be charged for in each case, but not less than 24,000 pounds per carload. I trust this heavy reduction in our local rates will enable you to do a large business over our line. As regards our guaranteeing you as low net rates as other shippers are charged, I have repeatedly assured you that our rates are the same to all shippers, and I do not know that I can do any more than already stated in this matter."

The error seemed so strange that we inquired of the Commission whether the letter, as submitted in evidence, actually contained the sentence in question. The reply was that it did; but that the omission was not a material one, since the same restriction was implied in a subsequent sentence actually quoted, and that in any event a rate from Cairo to New Orleans was a local one. On the last point there is room for difference of opinion. If all the shipments in tank cars from Cairo to New Orleans originated at Cincinnati, a paragraph which avowedly dealt with local rates might fairly be assumed not to apply to such business. The subsequent allusion to local rates is in the same general line, but not nearly so decisive. In our original article on the subject, we implied a doubt whether the case against the Illinois Central at this point was perfectly clear. That doubt was based on the second sentence with regard to the local rates. Had the omitted sentence been given, we should have interpreted the paragraph in a different way.

We are not criticising the Commission for the manner in which it interpreted a doubtful point, but for the form in which it presented the evidence. It not merely settled the point in such a way as to cast aspersions on the good faith of the company, but omitted to cite an essential part of the evidence which might fairly be interpreted in the company's favor; and it went on to say explicitly that no such evidence existed. No one will think of charging the Commission with intentional injustice; but there are oversights which do as much harm as intentional wrongs in weakening the authority of a body like the Inter-state Commerce Commission. This authority is largely a moral one. The public accepts what it says as law, because it is in a position to do justice to the facts. If public confidence in its statements of fact is weakened by instances of injustice, the influence of the Commission cannot fail to be impaired.

## Annual Reports.

*Ohio & Mississippi.*—Operations for the year ending June 30 were as follows:

| | 1888. | 1887. |
|---|---|---|
| Miles operated | 616 | 616 |
| Earnings—Passenger | $1,435,109 | $1,315,310 |
| " Freight | 2,268,672 | 2,407,825 |
| Total, including miscellaneous | 5,977,560 | 3,988,433 |
| Operating expenses | 2,733,418 | 2,650,481 |
| Net earnings | 1,244,142 | 1,337,952 |
| Fixed charges | 1,133,459 | 1,081,716 |
| Surplus for year | 110,683 | 256,236 |

Capital account is as follows:

| | |
|---|---|
| Common stock and certificates | $20,063,571 |
| Preferred " " | 4,030,000 |
| Funded debt | 16,246,500 |
| Floating and current debt | 1,160,523 |
| Surplus | 349,567 |
| | $41,850,161 |

There has been but little new construction during the year; only 7½ miles in all. But this forms an important means of reaching New Albany and Louisville via the Kentucky & Indiana Bridge Co.'s bridge and tracks.

The report of operations is somewhat unfavorable. It shows not merely an increase of expenditures, which is quite enough, but a diminution in freight receipts. This was not due to any falling off in rates. On the contrary, the average earnings per ton-mile increased from 0.720 cent to 0.763 cent, or nearly 6 per cent. But there was a most decided falling off in the volume of traffic—9½ per cent. loss in the tonnage and 11 per cent. in the ton-mileage. The average train-load also fell off from 176 tons to 165 tons. There were several causes for this. The crops along the line in 1887 were poor; the strike in the coke-producing districts of Pennsylvania caused some direct loss and a very large indirect one, while the Burlington strike is said to have had some effect.

In the passenger business there was a gain in every respect except in the matter of train loads; but the general result was not sufficient to offset the loss on freight.

It is not easy to compare the operating expenses of the two years, on account of the difference in arrangement of the items. This difference is due to the effort to comply with the requirements of the Inter-state Commerce Commission. It may be said in general that maintenance of way has somewhat increased, being $652,000 this year against $513,000 last year, a sign that the management has not attempted to practice any short-sighted or unwise economy. There has been an apparent increase in general expenses, and decrease in train service items, but this will be found on examination to be due rather to a rearrangement of accounts than to any real change in the methods of the road itself.

*Boston & Albany.*—Operations for year ending Sept. 30 were as follows:

| | 1888. | 1887. |
|---|---|---|
| Earnings—Passenger | $3,647,784 | $3,605,979 |
| " Freight | 4,385,817 | 4,493,588 |
| Total, including miscellaneous | $8,882,664 | $8,925,745 |
| Operating expenses | 6,471,956 | 6,373,636 |
| Net earnings | 2,410,708 | 2,552,109 |
| Interest and rentals | 740,900 | 740,900 |
| Dividends | 1,600,000 | 1,599,565 |
| Surplus for year | 69,808 | 211,644 |

Capital account is as follows:

| | |
|---|---|
| Capital stock | $20,000,000 |
| Funded debt | 10,858,000 |
| Current debt | 848,134 |
| Accumulated funds | 1,145,548 |
| Profit and loss | 497,022 |
| | $33,348,704 |

Here we find an increased expenditure and diminished receipts, though the changes are not so marked as in the Ohio & Mississippi. The loss in earnings is, in this case, due to a failure to maintain rates rather than to a positive diminution in the traffic. The ton mileage, it is true, fell from 406 millions to 405¼ millions, but the tonnage increased from 3,674,000 to 3,728,000. Passenger traffic increased from 10,715,000 to 10,992,000; passenger movement from not quite 192,000,000 to a little over 193,000,000. The company says in its report that the loss comes chiefly from the demoralization of rates on Western traffic. A better volume of business is predicted for the immediate future, but it is said that under present traffic methods it is doubtful whether the east-bound through business can be of much value at its best. With constantly recurring wars between the rival lines, the company considers itself fortunate if it can finish the year without actual loss on the through traffic.

In the different items of operating expense we find a decided increase under maintenance of way, but a reduction in maintenance of equipment. Transportation expenses show a trifling increase. Much of the cost of operating has been due to the exceptional severity of the winter. Taxes have also been extremely heavy.

It is well known that the Boston & Albany has for a long

time past adopted the policy of charging all improvements to current account. This makes the introduction steam heating from the locomotives, which has been applied on 146 cars, a charge upon earnings. The Board of Directors hardly expects to be able to maintain this policy in the immediate future, for the company is likely to be put to very great expense in abolishing highway crossings. Although a number of grade crossings have been recently done away with, there still remain 122 on the main line in Massachusetts, and 35 in New York, besides 357 private ways and farm crossings on the main line. With an increasing population, each year makes the danger from this source greater. The law on the subject is not such as to assist the company in prompt action, and an application is not unlikely to be made to the Legislature for assistance in this respect.

The consolidation of sleeping-car interests announced in another column is a notable event, the Richmond & Danville element, together with interests acquired elsewhere, serving to augment the business of the two old companies to such an extent that the new organization will have considerably more than twice the mileage of Mann and Woodruff combined. The lines now covered by the former aggregate about 3,500 miles, and those of the latter upwards of 2,000. The public demand for luxuriousness in parlor-cars—or rather the public satisfaction in the extravagant fittings and decorations furnished by competing lines—is so universal that mere elegance is apparently attainable under almost any administration; in fact, the common cars of many roads are now so beautifully finished that sleeping car companies are obliged to maintain a pretty high standard in order to keep up a difference—as millionaires' wives have had to take to wearing Russian sable to distinguish themselves from ordinary people who now wear sealskin. Competition, therefore, is chiefly in the personnel; and the service, it may be said, is not yet so exceedingly good on any of the lines as to preclude further improvement in this direction. Rivalry as between the two plans of arranging the berths—the ordinary American plan and Mann's separate compartments—is not so active as might be expected considering the distinctive merits and demerits of each, the success of the cars fitted up half Pullman and half Mann, which have been running between Chicago and St. Louis for some time, having been only moderate, we understand. The boudoir line between Chicago and Minneapolis has, however, secured a very satisfactory business.

The Railroad Commissioners of the State of New York have rendered their decisions, under the date of Oct. 23, in the cases of the applications of a number of railroad companies for extension of the date at which, under the law, they must have their passenger cars equipped for heating by other means than stoves or furnaces in, or attached to, the cars. It will be remembered that the time under the law expired Nov. 1, 1888, and many of the companies have asked for an extension, basing their applications generally upon the fact that no uniform system has been adopted, and that, consequently, interchange of cars equipped with couplers of different kinds would be very difficult. In the cases of the following companies the Commissioners extend the time to Jan. 1, 1889, viz.: The New York, Lake Erie & Western, the Fitchburg, the Elmira, Cortland & Northern, the Western New York & Pennsylvania, the Central Vermont as lessee of the Ogdensburgh & Lake Champlain, the Delaware & Hudson Canal Co., the Delaware, Lackawanna & Western, the Syracuse, Binghamton & New York, the Northern Central, the Grand Trunk, the Pennsylvania & New York Canal & Railroad Co. and allied lines, the Adirondack Railroad Co., and the Pullman's Palace Car Co. In the case of the Wagner Palace Car Co., it is said that this company has substantially equipped all of its cars with a continuous heating system, but that some of its cars come into the state from lines which have not yet adopted steam heating, and under these circumstances the stove in the cars must have a fire in it. The Board recommends that in these cases the fire should be allowed to die out within an hour of reaching the state line, and should be entirely extinguished when the car is attached to a train within the state. It decides that it is only proper that the company should have such special extension as is granted to the roads over which it operates. In the case of the Long Island Railroad, application was made for an extension to Dec. 1, 1888. This road has equipped 75 cars already, and has still 104 to fit up, and anticipates difficulty in getting them all ready by Nov. 1. The Board grants the extension until Dec. 1. In the case of the Newburg, Dutchess & Connecticut, an extension is granted until Nov. 1, 1889. This is for the reason that trains on this road are all liable to be mixed trains, and in consequence of the law prohibiting a freight car being attached to the rear of passenger coaches, it would be impossible to heat its passenger cars by steam without equipping all its freight cars with steam pipes. Moreover, the schedule time of trains on this road does not exceed 20 miles an hour. The law provides that the operation of the act does not apply to mixed trains, or to railroads less than 50 miles in length. While the road in question is 58 miles long, and therefore does not come within the letter of the law in exempting short roads, its operation is of such character as to bring it within the spirit of the law, and for that reason the extension is granted for one year.

It is reported that the Illinois Central has undertaken to run a special train for the "Twelve Temptations" theatrical company from Memphis to New Orleans in eight hours. The distance via Grenada is 394 miles, and the speed, including stoppages, would consequently be 49.25 miles per hour. The ordinary train is timed to run the distance in 14 hours 25 minutes, giving a speed of 27.3 miles per hour, including stoppages. The proposed train, therefore, would be run at about double the speed of the ordinary train. Such a high rate of speed is unprecedented in the South for any considerable distance, and if the train could be run to time, it would far surpass the record of the well-known West Shore run of July 9, 1885, when the distance between East Buffalo and Weehawken, 422.6 miles, was traversed in 9 hours 23 minutes, giving a speed, including stoppages, of 45.04 miles per hour. It will be seen that in this case the proposed speed is nearly 5 miles per hour greater, the distance being nearly 29 miles less, while the time is 83 minutes less.

The rumor is, however, unfounded. We are in a position to state that the Illinois Central has not undertaken to run a theatrical company from Memphis to New Orleans in eight hours, nor would it make the effort to do so. Such a run should be made upon railroads that are in the very highest condition of physical excellence; such condition as obtains, perhaps, on half a dozen railroads in the world. The management of the Illinois Central would only be too happy if the traffic and earnings in Mississippi and Louisiana were enough to meet the expense of putting the railroad in first-class order, to enable such excellent runs to be made. It is difficult to imagine how the story was started; probably through some over-zealous employé

The run will probably be made in about 12 hours, giving a speed of about 33 miles per hour including stops, which is a very fair pace for a southern road, though the difference between it and the speed proposed by the imaginative reporter is something enormous.

The London & Northwestern engine, the erection of which was recently illustrated in these columns,* forms in size no less than in design a striking contrast to the type of engines employed here to haul similar traffic on most of our great trunk lines. The engine is employed specially on coal and heavy mineral traffic, the wheels being nearly 12 in. less in diameter than those of the engines hauling general freight trains. The cylinders, valve gear, boiler, etc., are interchangeable between the two classes of engines, that principle being carried out very fully on the London & Northwestern. The total weight of the coal engine in working order is 66,200 lbs., or little more than half the weight of some of our latest consolidations. The cylinders are 17 by 24 and the drivers are 51 in. dia. on tread when new. The tractive power is consequently 136 lbs. per lb. average pressure in cylinders. These engines, however, haul tolerably heavy trains. The regular coal train weighs 1,425,000 lbs. and is 878 ft. long, both figures including engine and tender. The feat of erecting one of these engines in 25½ working hours was performed in February, 1878, and not in 1888 as stated recently in these columns. The performance, however, does not appear to have been illustrated or described at the time in our English contemporaries.

On a certain road two track watchmen were killed by trains last week, one on Tuesday and the other on Thursday, and both are reported to have been asleep on the track. This is a remarkable statement, and would hardly appear credible if it did not come from a reliable source. Apparently the men either had indulged in liquor or else were so stupid when sober as to make their bed on the track in preference to the roadside. In either case the superior officer who employed them must feel that as *watchmen* his appointees were pretty complete failures. We understand each man had to watch his section for 24 hours continuously. It is possible that trains were sufficiently infrequent to justify such working hours, but it hardly seems likely. At all events, if a road desires to work men in that way it should take care to select men who will know enough to save their own necks, however much they may neglect their duty to the employer. It is a question whether the disgrace to the road is not as great in this case as it would have been if a neglected washout had wrecked a train.

## NEW PUBLICATIONS.

*Poor's Directory of Railway Officials*, 1888. H. V. & H. W. Poor, New York. Price, $2.50.

This directory is now pretty well known, as this is its third annual edition. It contains an alphabetical list of railroads of North America, with their officers, lists of various auxiliary companies, of manufacturers and contractors, and of associations and commissions. There are also special classified lists of officers, as chief engineers, master mechanics, etc., and an alphabetical index of railroad officials. A list is given also of railroads and tramways in Mexico, the West Indies and the South American countries, with some particulars of their capital accounts, operations, equipment, mileage, etc.

## Foreign Technical Notes.

The Pilatus Railroad, an account of which was given in the *Railroad Gazette* for Feb. 4, 1887, p. 70, was opened on the 28th of August of this year.

The Swiss government has directed the Gotthard Railroad Co. to build snow protections on the south approach to the tunnel to insure the traffic from danger by avalanches, which gave serious difficulty last spring. The cost of the proposed works is estimated at $100,000.

The London General Omnibus Co. carried in the first six months of 1888, 46,325,713 people, against 43,809,330 in the first half of 1887, and ran 8,661,342 miles in 1888 against 8,364,451 miles in 1887. The competition of another company has reduced the receipts for the half year some $6,000 in spite of the larger business.

* See *Railroad Gazette*, Sept. 28, 1888.

The total length of the railroad system of the Austrian Empire at the end of 1887 was 8,869.6 miles, an increase of 334.8 miles over the previous year. This was divided among 59 owners, of which 3 curiously enough were foreign countries, that is, Prussia, Bavaria and Saxony, and one of the remainder was a provincial government (Bosnia-Herzegovina).

The different kinds of state management are divided as follows:

| | Miles. |
|---|---|
| State railroads under Austrian state management | 2,358.5 |
| " " " foreign " | 611.2 |
| Private " managed for the account of the government | 506.7 |
| Private railroads managed by government for the account of owners | 416.1 |

## TECHNICAL.

### Locomotive Building.

The Rhode Island Locomotive Works, of Providence, R. I., have completed the first of the three locomotives that they are building for the Western, of Alabama.

The Charleston, Cincinnati & Chicago has just received three 40-ton locomotives for use on the Rock Hill Division.

The Manchester Locomotive Works, of Manchester, N. H., has delivered two locomotives to the New Brunswick road.

The Nashville, Chattanooga & St. Louis is having built four consolidated freight and three passenger locomotives at the Rogers Locomotive Works.

After close competition with English and French manufacturers, H. K. Porter & Co., of Pittsburgh, have received an order from the Japanese Government for two of their Mogul 42 in. gauge locomotives, to be used on the Paranai Railroad, in the island of Yesso.

### Car Notes.

The Clayton Land Co., of Birmingham, has completed 10 platform cars for the Georgia Pacific.

The Ohio Falls Car Co., of Jeffersonville, Ind., has just delivered six passenger cars to the South Carolina road. The road has also recently received 200 freight cars.

### Bridge Notes.

The new bridge of the Norfolk & Western across New River, near Radford, Va., was completed this week.

The Pittsburgh Bridge Co. has been awarded the contract for furnishing the girders for the viaduct on Dearborn avenue in Chicago. The contract price is $17,200. The iron work was let to the Lassing Bridge & Iron Works for $7,367. The Chicago Forge & Bolt Co., Riter & Conley, of Chicago, Gottlieb & Co., of Chicago, the Rochester Bridge & Iron Works, and the King Iron Bridge Co., of Cleveland, also bid on the work. The viaduct is to be completed by Feb. 1, 1889. The entire length will be 414 ft. The truss-span will be 206 ft., the north girder span 156 ft., and the south girder span 52 ft. The width of the structure is to be 42 ft. The south approach will have a rise of one foot in twenty.

A new bridge is to be built across the Saginaw River at Bay City, Mich.

The Chicago Forge & Bolt Co. has the contract for constructing the superstructure of the Western avenue viaduct at Chicago at $17,800.

The Missouri Valley Bridge & Iron Works, of Leavenworth, Kan., has been awarded the contract for building the viaduct at Sixth street in Topeka for $35,000.

A company has been organized at Pittsburgh, with James R. Scott as President, and with a capital stock of $1,000,000, to build a viaduct and bridge from Stockton avenue, Allegheny City, to Fifth street, in Pittsburgh.

The Leavenworth & Platte Bridge Co. has been chartered in Kansas, with office at Leavenworth, to build a pontoon bridge across the Missouri River. Directors: Vinton Stillings, J. W. Engle, W. B. Nickels, J. C. Lyle and I. W. Cramer.

The Topeka Bridge Construction Co. has been organized to build a toll bridge at some point over the Kansas River near Topeka, and to engage in bridge building generally. The directors are G. H. Evans, J. S. Earnest, J. B. Parnham, W. W. Minspeaker, C. E. Lane, E. A. Austin, W. M. Dignon, J. B. Hibben, W. T. Cavanaugh, R. B. Kepley, J. J. Cox, J. A. McCall. The capital stock is $500,000.

### Manufacturing and Business.

Wilson Brothers & Co., civil and consulting engineers, have removed their office to the Drexel Building, Philadelphia, Pa.

The new station of the Central of New Jersey, at Jersey City, will be lighted with 2,200 Edison lights.

The Bristol Safety Brake Co., of Milwaukee, has been incorporated, with a capital of $500,000, by Frank Middleton, John A. Hinsey and others.

The Staten Island Rapid Transit Co. has equipped one of its engines with the Rushforth feed-water heater.

At the Cincinnati Centennial Exposition the Egan Co. had a large and very fine exhibit of their wood-working machines, and received the medal of superiority for all those exhibited, among which were the following: No. 4 planer and smoother, dovetailer, slat tenoner, wood-worker and molder combined, band and scroll saws and shapers.

Messrs. Shailer & Schniglau, of Chicago, have been awarded the contract for building the substructure and superstructure of the extension of the iron pier at Marine Park, Boston. Also the contract for the iron roof of the Central Pumping Station, Chicago.

The Westinghouse Air Brake Co. has purchased a large tract of ground between Turtle Creek and Braddock, Pa., for the new plant there, and a large force of men is now laying the foundations for a new freight depot and shops.

The Bentley Knight Electric Railway Co., of New York, has commenced laying a conduit for the West End Street Railway Co., of Boston. The track will be laid from the junction of Ipswich and Beacon streets through Chester Park and Boylston street to Park place, a distance of 1½ miles. As it will be double track the entire distance, the length of conduit will be 3 miles.

The Beckett Foundry & Machine Co., of Arlington, N. J., has shipped the past week a 25-ton steam hoist to one of the iron mines of the estate of J. Cooper Lord, Port Oram, N. J. The hoist has two cylinders 15 × 24 in., and two friction drums 6 ft. diameter. The company also has orders for mining machinery from South America and Mexico.

A company is being formed to purchase the United States and foreign patents on an addition to ordinary car trucks invented by Chas. C. Brown, of Duluth, Minn. It is stated that the invention is very simple and involves no alteration in existing trucks.

### Iron and Steel.

The National Rolling Mill of McKeesport, Pa., is to construct a 24-in. plate mill department, to manufacture sheets for making 24-in. tubes. The new department will be placed in operation about Jan. 1. and will employ a large number of men.

Work on the new steel rail mill at Duquesne, Pa., on the line of the Pennsylvania Railroad, is being pushed rapidly. It is thought that the plant will be ready for operation by the first of the year.

The Magnetic Iron Ore & Steel Co., recently chartered in South Carolina, has purchased for $60,000 the greater part of the magnetic iron ore tract, near the town of Black's, in York County, S. C., on the Charleston, Cincinnati & Chicago. The company will at once build a steel furnace and rolling mills on the line of this road.

### The Rail Market.

*Steel Rails.*—During the week orders have been placed by the Vanderbilt system for 21,500 tons of rails. Only part of the order was placed with Eastern mills. A Southern road is negotiating an order for 10,000 tons, and inquiries are in the market from an Oregon road and a transcontinental line. Eastern mills are asking $28@$28.50, but quotations are generally $27.50@$28.

*Old Rails.*—Western mills this week have bought 7,000 tons of old rails, and a Virginia mill has secured 3,000 tons from a North Carolina road at $24. Small lots are sometimes offered at $23 for tees, but the stock is generally held at $23.50.

### Crossings on the Chicago, Santa Fe & California.

In building the new line of the Atchison, Topeka & Santa Fe from Chicago to Kansas City unusual care was taken to avoid grade crossings of other roads; and in 458 miles there are 16 railroad crossings over or under grade. One of the most important is that at Rock Creek, four miles east of Kansas City, where eight tracks are crossed by a viaduct 270 ft. long.

### The Nicaragua Canal.

An act to incorporate the Maritime Canal Co. of Nicaragua has been introduced in the Vermont Legislature. This bill was drawn by Senator Edmunds, and is substantially the same as passed the United States Senate. The incorporators are the same in both cases.

### Accidents to English Railroad Employes.

The following table, compiled from the British Board of Trade returns for the year 1887, shows the total number of employés killed and injured by the movement of trains or cars during the year 1887.

| | Killed. | Injured. |
|---|---|---|
| Coupling and uncoupling cars | 26 | 232 |
| Switching | 89 | 920 |
| Caught between cars | 9 | 55 |
| Falling between train and platform | 5 | 33 |
| Working on permanent ways and sidings | 99 | 97 |
| Walking, crossing or standing on line on duty | 93 | 127 |
| Other accidents connected with the movement of trains or cars | 101 | 611 |
| Total employés killed and injured | 422 | 2,075 |

The number killed and injured in coupling and uncoupling shows a considerable decrease as compared with the record of former years, and switching generally is not so dangerous when the increase in the number of men employed is taken into account.

The decrease in the whole number of employés killed and injured in train accidents, and while engaged in their several operations during a series of years is shown by the following table:

| | By train accidents. | | Other accidents on railroads. | | Total accidents to No. employed. | |
|---|---|---|---|---|---|---|
| Year. | Killed. | Injured. | Killed. | Injured. | Killed. | Injured. |
| 1874 | 46 | 271 | 742 | 2,544 | 1 in 320 | 1 in 89 |
| 1875 | 21 | 239 | 744 | 3,379 | 1 in 334 | 1 in 70 |
| 1876 | 28 | 236 | 645 | 2,364 | 1 in 386 | 1 in 100 |
| 1877 | 22 | 154 | 620 | 2,099 | 1 in 414 | 1 in 123 |
| 1878 | 15 | 156 | 529 | 1,847 | 1 in 500 | 1 in 135 |
| 1879 | 8 | 118 | 444 | 1,836 | 1 in 619 | 1 in 143 |
| 1880 | 23 | 118 | 523 | 1,962 | 1 in 531 | 1 in 139 |
| 1881 | 19 | 168 | 502 | 2,278 | 1 in 576 | 1 in 123 |
| 1882 | 21 | 153 | 532 | 2,423 | 1 in 570 | 1 in 122 |
| 1883 | 11 | 87 | 543 | 2,373 | 1 in 596 | 1 in 134 |
| 1884 | 23 | 115 | 523 | 2,204 | 1 in 634 | 1 in 149 |
| 1885 | 13 | 81 | 438 | 2,036 | 1 in 768 | 1 in 163 |
| 1886 | 4 | 81 | 421 | 1,929 | 1 in 815 | 1 in 172 |
| 1887 | 8 | 109 | 414 | 1,966 | 1 in 821 | 1 in 167 |

From 250,000 in 1874 the number of railroad employés has increased to 346,426 in 1884, which figure is taken for the three following years. Accidents due to the forgetfulness of signalmen in block-telegraph working were not so numerous in 1887 as in former years.

### Locomotives for Canal Boats.

Experiments recently conducted by the London & Northwestern to test the feasibility of towing canal boats with locomotives running on the towing path alongside the canal instead of with horses have not proved satisfactory, and led to considerable oscillation and irregularity in the motion of the locomotives. The idea of employing locomotives for traction purposes in this way is now definitely abandoned. Its adoption would have involved the laying down two tracks along the whole length of the canal, which would have also required deepening and its banks making stronger in order to withstand the wash from the boats, while considerable alterations would have been necessary to existing bridges.

Small steel tugs, each hauling several barges, will now be tried, and although the present state of the canal is such that in many places only a very low rate of speed can be maintained, yet the saving of horse power and horse attendance will, it is estimated, form a considerable item in the more economical working of the canal. Small steam tugs for canal purposes have been used for the last 25 years, and found both convenient and economical.—*Practical Engineer.*

### Steamer for Prince Edward's Island.

The Fairfield Shipbuilding and Engineering Company, of Glasgow (Scotland) recently launched the "Stanley," a vessel for navigating the straits between Prince Edward's Island and the mainland. The forefoot of the vessel is cut away to allow the vessel to mount the ice instead of dashing through it. She will draw, when fully loaded, about 3 ft. forward, and she is therefore able to run on the top of the ice. The fore compartments may then be filled with water with powerful pumps specially provided for the purpose. This great weight will, it is expected, cause the ice to break, and the ship is thus freed. The vessel is of the following dimensions: 200 ft. long between perpendiculars, 32 ft. extreme breadth, 20 ft. 3 in. depth molded, and her gross tonnage is 1,000. She has been built under special survey to class 100 A 1 at Lloyd's, but in order to resist the pressure of ice, which renders navigation a matter of extreme difficulty and of occasional danger, the scantlings—especially forward—are much in excess of Lloyd's requirements. First-class accommodation will be provided for about thirty in a deck-house on the main deck forward, while for the second-class passengers arrangements will be made 'tween decks aft. The officers and engineers will have rooms in the deck-house on the main deck, and the crew will be berthed 'tween decks forward. She is fitted to comply with the Board of Trade and Canadian regulations for passengers, and a special arrangement of steam pipes will give heat to all the passengers' berths. The engines are of the triple-expansion type, with three inverted cylinders, 24 in., 40 in., and 60 in. dia., by 42 in. stroke. The crankshafts are built of mild steel, and the propeller blades are of steel. Steam is to be supplied from two double-ended steel Scotch boilers, working at 160 lbs. per sq. in. The speed, when loaded, is estimated at 15 knots an hour.

### Underground Railroad in Buenos Ayres.

An underground railroad is proposed in Buenos Ayres, the size of the city and density of the street traffic having outgrown the capacity of the numerous existing surface railroads The underground or Metropolitan line will connect all the railroad systems now centering in Buenos Ayres. The site of the central station is not yet decided upon, but it will probably be near the new docks. The arrangement of the station is that adopted in London. The offices will be erected on bridges, the lines passing underneath. Staircases lead from the bridges to the various platforms. The proposed station has accommodation for eight district systems of railroad.

## General Railroad News.

### MEETINGS AND ANNOUNCEMENTS.

**Dividends.**

Dividends on the capital stocks of railroad companies have been declared as follows:

*Boston & Maine*, 4 per cent., payable Nov. 15.

*Chicago & Eastern Illinois*, 1½ per cent., quarterly on preferred stock, payable Dec. 1.

*Chicago & Indiana Coal*, 1½ per cent. on preferred stock, payable Dec. 1.

*New York, Providence & Boston*, quarterly, 2½ per cent., payable Nov. 10.

*Northern (N. H.)*, 3 per cent., payable Nov. 1.

**Meetings.**

Meetings of the stockholders of railroad companies will be held as follows:

*Arkansas & Gulf*, special meeting, Arkansas City, Ark., Dec. 1.

*Birmingham Mineral*, annual meeting, Birmingham, Ala., Nov. 12.

*Brooklyn, Bath & West End*, annual meeting, Brooklyn, N. Y., Nov. 8.

*Brooklyn & Montauk*, annual meeting, 120 Broadway, New York City, Nov. 7.

*Buffalo, Rochester & Pittsburgh*, annual meeting, 20 Nassau street, New York, Nov. 19.

*Carolina, Cumberland Gap & Chicago*, annual meeting, Aiken, S. C., Nov. 6.

*Downington & Lancaster*, 233 South Fourth street, Philadelphia, Pa., special meeting Nov. 5.

*East Tennessee, Virginia & Georgia*, special meeting, Knoxville, Tenn., Dec. 22, to consider the approval of the lease to the Richmond & Danville.

*Fort Worth & Denver City*, annual meeting, Fort Worth, Tex., Dec. 11.

*Indianapolis, Decatur & Western*, annual meeting, South Meridian street, Indianapolis, Ind., Nov. 6.

*New York, Lake Erie & Western*, annual meeting, 21 Cortlandt street, New York, Nov. 27.

*Philadelphia, Germantown & Norristown*, annual meeting, Philadelphia, Pa., Nov. 5.

*Raleigh & Augusta Air Line*, annual meeting, Raleigh, N. C., Nov. 8.

*Raleigh & Gaston*, annual meeting, Raleigh, N. C., Nov. 8.

**Railroad and Technical Conventions.**

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *American Association of Railway Chemists* will hold its next meeting in Baltimore, Md., Jan. 14, 15 and 16.

The *New England Railroad Club* meets at its rooms in the Boston & Albany passenger station, Boston, on the second Wednesday of each month.

The *Western Railway Club* meets the third Tuesday in each month in the Phenix Building, Chicago.

The *New York Railroad Club* meets at its rooms, 113 Liberty street, New York City, at 7:30 p. m., on the second Thursday in each month.

The *Central Railway Club* meets at the Tifft House, Buffalo, the fourth Wednesday of January, March, May, August and October.

The *American Society of Civil Engineers* holds its regular meetings on the first and third Wednesday in each month, at the House of the Society, 127 East Twenty-third street, New York.

The *Boston Society of Civil Engineers* holds its regular meetings at its rooms in the Boston & Albany station, Boston, at 7:30 p. m. on the third Wednesday in each month.

The *Western Society of Engineers* holds its regular meetings at its hall, No. 67 Washington street, Chicago, at 7:30 p. m., on the first Tuesday in each month.

The *Engineers' Club of Philadelphia* holds regular meetings at the house of the Club, 1,122 Gerard street, Philadelphia.

The *Engineers' Society of Western Pennsylvania* holds regular meetings on the third Tuesday in each month, at Pittsburgh, Pa.

The *Engineers' Club of Kansas City* meets at Kansas City, Mo., on the first Monday in each month.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., on the third Saturday in each month.

**American Society of Mechanical Engineers.**

Our report of the Scranton meeting of this body included a part of Wednesday's proceedings. The last business of that day was the topical discussion on

STEEL.

Several samples of peculiar phenomena in the treatment of steel were exhibited and commented upon.

Mr. Main having called attention to the breakage of steel shafting in his experience, which had been replaced by iron, Professor Denton referred to the breakage of iron shafts on six ferryboats plying between New York and Hoboken. One of them was a new shaft which had been in use less than a year, others from 3 to 5 years. All of these boats had iron paddle-wheels. In looking up this subject he had occasion to follow up the steel shafts which were made by Krupp for boats on the Alleghany River, and found that some of them had broken. A piece was taken out from a shaft as near as possible to the fracture and sent to Germany for test, but no weakness was discovered in any tests made, and it was thought that the shaft was not large enough, so another was made 2 in. larger, which he understood had since been replaced with an iron shaft for the reason that it took too long to obtain one from abroad. In the case of ocean steamers, it was now the practice to watch for the beginning of a crack, and replace the shaft before it breaks.

Professor Sweet called the attention of the meeting to changes which took place in the length of standard steel gauges, and inquired as to the length of time which should be allowed to elapse before they were sent out. He also stated, on the authority of the manufacturer, that a steel gauge, which was a true cylinder, after standing on end for a time had become larger in the north and south direction. Its position was then changed so that the points of compass were reversed, when it became larger in its new position in the north and south direction which had previously been that of east and west.

Mr Bond, of the Pratt & Whitney Co., said that there was a possibility of preventing such changes by permitting the gauges to remain six months after tempering before finishing them up. The change depended a great deal on the hardness of steel. It was necessary to keep them away from any temperature above the degree at which they were finished.

At 9.25 p. m. the session adjourned in order to permit the members to accept an invitation from the President of the Suburban Electric Railway Co. for an excursion over their line.

At the closing session on Thursday evening a paper by C. J. H. Woodbury on "Electric Welding" was read and discussed. An abstract is given elsewhere.

**Arkansas Society of Engineers, Architects and Surveyors.**

The second annual meeting of the Society will be held at Little Rock, on Nov. 22, 23 and 24, 1888. The following are among the papers to be read: "Little Rock: Its Municipal Improvements," by G. P. C. Rumbough, formerly City Engineer, Little Rock, Ark. "Highway Bridges (Howe and Queen Trusses)," by Lee Treadwell, Fayetteville, Ark. "Adaptability of the Various Kinds of Timber in Arkansas for Railway Purposes," by E. C. Buchanan, Little Rock, Ark. "Concrete in Construction," by J. T. Hogane, Texarkana, Ark. "Proportionate Errors in Surveying," C. W. Stewart, U. S. Asst. Engr., Amelia, Ark. "What is Generally Expected of a Surveyor," by W. E. Keefer, Hindsville, Ark. "Design and Construction of Hydraulic Rams," by Ge C. Schoff, Little Rock, Ark. "The Uses of the Plane Table," by D. C. B. Aikin, Fayetteville, Ark. "Electric Lighting of Towns," by W. E. Anderson, Fayetteville, Ark. Topical Discussion, by members. F. W. Gibb, of Fayetteville, Ark., is Corresponding Secretary.

**Engineers' Club of Kansas City.**

The following programme for the winter of 1888-1889 is announced:

Nov. 19.—Present Status of the Electric Railway Problem, by Dr. Wellington Adams; and a paper on Shrinkage of Material and Settlement of Embankments, by a member of the club.

Dec. 3.—The Steam Engine; its Beginning, Growth and Place in the Industries of To-day, by C. A. Burton.

Dec. 5.—Annual meeting—Reports of officers and committees, nomination of officers for 1889.

Jan. 7.—Election of officers for 1889—Address of retiring president by Wm. B. Knight.

Jan. 21.—Electric Railways, by A. N. Connett.

Feb. 4.—The Details of Iron Highway Bridges, by E. W Stern.

Discussions on the above papers are invited.

**Engineers Club of Philadelphia.**

A regular meeting was held Oct. 20. The following were elected active members: Messrs. Chas. H. Davis, Wm. E. Good, James Murray Africa, E. A. Herring, H. Kauffman, Jr., James D. Moffet, R. Taylor Gleaves and Charles Lindström. A report was presented by Messrs. Henry B. Seaman, Chairman, Wm. H. Burr and Henry G. Morse, acting as a committee of the club to co-operate with committees of the Engineers' Club of Kansas City and the Western Society of Engineers in the matter of design and inspection of highway bridges. The report was as follows:

"We have carefully considered the subject matter of the communications from the organizations above named, and are of the opinion that the purposes of the movement can be best served on the basis of the general plan outlined by them.

"We will broadly state that, in our opinion, an officer known as 'State Engineer' should be appointed in all states where that officer is not now found, and that copies of strain sheets of all highway bridges, showing sections, sizes and dimensions, should be deposited and kept on open file in his office, together with such working drawings as will convey to a competent engineer an accurate knowledge of their general design and details. It may be also advisable to deposit a similar set of strain sheets and plans in the office of the county clerk or other proper county official.

"We are also of the opinion that the construction and maintenance of highway structures should be constantly subject to the inspection and authoritative supervision of that engineer to such an extent as to insure the proper discharge of the duties of counties, towns and cities, in regard to their highway structures, without in any way relieving them of such responsibilities.

"We shall be glad to be advised by the Engineers' Club of Kansas City, and the Western Society of Engineers of the legislative or other measures which they propose, in order to serve the objects of this movement."

Mr. H. W. Spangler presented a paper on Multiple Expansion Engine Cards, which was discussed by Messrs. Codman and Marichal.

The Secretary presented, for Mr. C. A. Sundstorm, a paper upon the Theory of Elastic Curves.

Railroad engineers generally acknowledge the great advantage in using transition curves, which, if properly laid out, make the elevation of the outer rail directly proportional to the degree of curvature. The objections to these curves are the laborious calculations required in computing the co-ordinates and the difficulty in placing them on the ground. The engineers' transit is, without doubt, the most accurate and the most comfortable instrument for railroad surveying, and in the method of staking out transition curves now laid before the club, the points in the curve are obtained by means of this useful instrument, without other preliminary calculations than the computation of the tangent distance, all other functions of the curve being obtained from tables.

Mr. R. P. Snowden exhibited two specimens of old rails.

One was a piece of the first rail used by the Camden & Amboy Railroad, weighing about 20 lbs. per yard. This

rail was laid on a beveled stringer, and spiked only on the outside of rail. About eight miles of this was laid from Cooper's Creek eastward. It was found unsuitable, causing many accidents. No splice was used, and the ends curled up, making "snake heads," as remembered by some of our older members. It was replaced by English rail, 40 lbs. per yard, of a pattern similar to the old 67-lb. rail of 1878.

The other specimen shown was a piece of 7¼-in. rail, laid about 1847, near Bordentown shops, Ernston, and Camden. It was of slightly differing sections, weighing about 90 lbs. to the yard, and was put down as an experiment. It was laid with wooden joints. The experiment was unsuccessful, the height of rail making it impossible to keep it from turning over, even with the wooden brace blocks which were put on soon after the rail was laid.

The Secretary exhibited, for Mr. Frank H. Taylor, a section of hand rail from bridge over railroad, involving the question of the effects of gases, etc., from stacks upon iron.

It was a section of hollow wrought-iron hand rail taken from the bridge at Girard and Belmont avenues, over the Pennsylvania, where it had been constantly exposed to the gases from the locomotives. It had been in place since 1875 or 1876, and is interesting as showing how little the section has wasted away from rust. The sample has been out in the weather from March to Oct. 1, which accounts for the surface rust. The point of interest is that inside, where no paint could be used for a long period of a dozen years, the section wasted so little.

The Secretary exhibited specimens of blue prints made on Linaura, a new prepared linen, of apparently excellent quality and almost unlimited durability, showing excellent blue color, very white lines, and white back.

**Michigan Engineering Society.**

The annual meeting of the Board of Directors was held at Lansing, Mich., Oct. 10. The following officers were elected: President, George E. Steele, of Traverse City; Vice-President, Joseph Ripley, of Detroit; Secretary, F. Hodgman, of Climax; Treasurer, G. S. Piersou, of Kalamazoo. Directors: Prof. M. E. Cooley, of Ann Arbor, and W. Appleton, of Lansing. The next annual convention will be held at Lansing, beginning Tuesday, Jan. 22, 1889.

Arrangements have been made for the preparation of papers on "Explosives in Engineering," "The Application of Photography to Surveying and Engineering," "The Nicaragua Canal Surveys," "Smelting Works and Machinery," "Tests of Michigan Woods," "Water-Works Machinery," "Logging Railways and Equipment," "Railway Location in Northern Michigan," "Railroad Construction and Location," "Railway Maintenance and Track Accounts," "Lands Surveys in the Forests of Michigan," "Practical Mining," "Paints for Railroads and Bridges," etc.

**Rewards for Meritorious Discoveries and Inventions—Franklin Institute.**

The Committee on Science and the Arts, of the Franklin Institute, request that the fact be made known that the committee is empowered to award, or to recommend the award of, certain medals for meritorious discoveries and inventions, which tend to the progress of the arts and manufactures. These medals are:

*The Elliott Cresson Medal (Gold).*—This medal will be given, after proper investigation and report by sub committee, either for some discovery in the arts and sciences, or for the invention or improvement of some useful machine, or for some new process or combination of materials in manufactures, or for ingenuity, skill or perfection in workmanship.

*The John Scott Legacy Premium and Medal. (Twenty Dollars and a Medal of Copper).*—The John Scott Legacy Premium and Medal was founded in 1816, by John Scott, a merchant of Edinburgh, Scotland, who bequeathed to the City of Philadelphia a considerable sum of money, the interest of which should be devoted to rewarding ingenious men and women who make useful inventions. The premium is not to exceed twenty dollars, and the medal is to be of copper, and inscribed "*To the most deserving.*"

Upon request therefor, from interested parties, made to the Secretary of the Franklin Institute, full information will be sent respecting the manner of making application for the investigation of inventions and discoveries; furthermore, the Committee on Science and the Arts will receive and give respectful consideration to reports upon discoveries and inventions, which may be sent to it with the view of receiving one or the other of the awards herein named, and full directions as to the manner and form in which such communications should properly be made will be sent on application.

WM. H. WAHL, Secretary.

## PERSONAL.

—T. R. Morgan, Division Master Bridge Builder of the Boston & Albany, died in Springfield, Mass., Oct. 24, aged 46. He had been in the service of the road 22 years.

—Mr. R. H. Soule has been appointed General Agent of the Union Switch & Signal Co., and also of the Standard Car Heating & Ventilating Co. He will take special charge of the introduction of the Westinghouse friction buffer, and will also give some attention to the introduction of the Standard Co.'s system of continuous steam heating.

—William F. Fitch, General Manager of the Fremont, Elkhorn & Missouri Valley, has resigned to succeed Andrew Watson as General Superintendent of the Duluth, South Shore & Atlantic. He will have the title of General Manager. Mr. Fitch has been connected with the Chicago & Northwestern 17 years, and was appointed to the position he has just resigned in January, 1886. It is stated that H. G. Burt, Chief Engineer of the Chicago & Northwestern, will succeed him on the Fremont, Elkhorn & Missouri Valley.

—W. H. Holcomb, General Manager of the Oregon Railway & Navigation Co., has been chosen Vice-President of the Union Pacific, to succeed the late Thomas J. Potter as chief executive officer resident at Omaha. Thomas L. Kimball has been chosen General Manager and C. S. Mellen Assistant General Manager. Mr. Holcomb commenced railroad life in 1856 when he was 17 years old as freight brakeman on the Peoria & Oquawka, now part of the Chicago, Burlington & Quincy. He was rapidly promoted, and in 1877 became Receiver of the road. He held this position for five years, resigning July 8, 1882, to become General Superintendent of the Chicago & Iowa. In 1885 he was appointed General Superintendent of the Chicago, Burlington & Northern. He resigned this position in 1887 to become General Manager of the Oregon Railway & Navigation Co.

Mr. Kimball is 57 years old, and has been connected with railroad service for 29 years, nearly twenty-two of which have been in the traffic department of the Pennsylvania. Mr. Kimball entered the service of the Union Pacific in 1871, and has been General Passenger and Ticket Agent, Assistant General Manager, General Traffic Manager, and Assistant to First Vice-President.

Mr. Mellen has been connected with Eastern roads until last spring, when he resigned his position of General Superintendent of the Boston & Lowell to become General Purchasing Agent of the Union Pacific.

## ELECTIONS AND APPOINTMENTS.

*Atlantic, Gulf & Havana.*—Henry A. De Land, of De Land, Fla.; John B. Stetson, of Philadelphia, Pa.; Samuel J. Fox, and Benjamin Mason, are directors of this recently incorporated Florida company.

*Central Massachusetts.*—The stockholders have re-elected the old Board of Directors, and S. N. Aldrich has been re-elected President, and George F. Seymour Secretary and Treasurer.

*Chattanooga, Cleveland & Murphy.*—E. Watkins is President, H. E. Colton Vice-President, and W. G. McAdoo, Jr., Secretary and Treasurer, with headquarters at Chattanooga, Tenn.

*Chicago, Kansas & Nebraska.*—Granville A. Kimball has been appointed Assistant General Freight Agent, with headquarters at Denver.

*Chicago & Northwestern.*—C. C. Pudor, Assistant Engineer of the Winona & St. Peter and Dakota Central divisions, has been appointed Engineer of the Madison division, with headquarters at Madison, Wis. Harry Battin will succeed Mr. Pudor, with headquarters at Winona, Minn.

*Columbia & Northern.*—The officers of this Dakota company are John D. Lavin, President; G. M. Lyon, Secretary, and A. H. Hildebrand, Chief Engineer. The principal office is at Columbia, Dak.

*Danbury & Norwalk.*—The annual election of officers was held last week, and the following were elected: President, F. St. John Lockwood; Vice-President, C. H. Merritt; Secretary and Treasurer, C. E. Robinson; Register, L. C. Betts; Directors, F. St. John Lockwood, William H. Starbuck, Charles L. Rockwell, Charles H. Merritt, John H. Macauley, William B. E. Lockwood, John H. Perry, Eben Hill, J. A. Bostwick, Stephen H. Smith.

*East Chicago, Kensington & Lamont.*—The incorporators and first board of directors of this Illinois company are: William M. Wilson, William J. Stapleton, E. Parmalee Prentice, E. A. Bryan and Frank C. Smith, all of Chicago.

*East & West Alabama.*—Charles P. Ball, of Montgomery, Ala., has been appointed Receiver to succeed Capt. John Postell, resigned.

*Georgia & Alabama Midland.*—The stockholders of this consolidation of the Georgia Midland and the Alabama Midland companies have chosen the following directors: C. J. Knox, A. St. Clair Tennille, O. C. Wiley and L. Henderson, of Troy, Ala.; John R. Kelly, of Newton; J. W. Dowling, of Ozark, Ala.; Josiah Morris and W. F. Joseph, of Montgomery, and J. B. Newcombe, of New York. The officers are: O. C. Wiley, President; A. St. Clair Tennille, Vice-President; J. C. Henderson, Treasurer, and W. F. Joseph, Secretary.

*Illinois & St. Louis.*—The following officers and directors were elected at a meeting in Belleville, Ill., last week: J. W. Branch, President; C. H. Sharman, Vice-President and General Manager; P. T. Burke, Secretary and Treasurer; J. W. Branch, C. S. Greeley, W. A. Hargadine, John D. Perry, Theodore G. Meier, C. H. Sharman, George R. Lockwood, Russel Hinckley, G. A. Koerner, E. H. Wangelin, J. B. Reutebler, A. C. Hucke, L. D. Turner, Jefferson Rainey and Julius Kohl, Directors.

*Kansas City & Southern.*—David McCool has been appointed General Roadmaster and W. E. Reeve Master Mechanic.

*Louisville, St. Louis & Texas.*—James P. Helm, of Louisville, Ky., has been appointed Chief Attorney.

*Missouri, Kansas & Texas.*—The following appointments are announced: W. O'Herrin, Master Mechanic, headquarters at Parsons, Kan.; Robert Walker, Master Car-Builder, headquarters at Sedalia, Mo.; John Montgomery, Jr., General Attorney, office at Sedalia.

*New Westminster, Bellingham Bay & Seattle.*—The names and addresses of the officers and trustees are as follows: President, Eugene Canfield; Vice-President, Sutcliffe Baxter; Secretary, William R. Forrest; Treasurer, John H. McGraw; General Manager, C. M. Sheafe. Trustees: Eugene Canfield, D. B. Jackson, F. H. Richards, N. H. Owings, J. H. McGraw and Wm. R. Forrest. The principal office is in Seattle, W. T.

*Norfolk & Western.*—C. P. Bonner has been appointed Division Engineer in charge of the Cripple Creek extension.

*Northern Michigan.*—The following are the names and addresses of the officers of this new company: C. A. Wright, Vice-President and General Manager, Hancock, Mich.; James B. Sturgis, Secretary and Treasurer, Houghton, Mich., and C. A. Robinson.

*Perry & Maysville.*—The following are the incorporators of this Illinois company: A. Hinman, Alexander Dorsey, Joseph Shasted, James H. Harrison and G. W. Witham, all of Perry, Pike County.

*Puget Sound Shore.*—At a recent meeting of the stockholders, the following trustees were elected: Arthur A. Denny, T. H. Tyndale, Charles F. Munday, E. L. Terry and Ira A. Nadeau. The trustees elected the following officers: T. H. Tyndale, President; Arthur A. Denny, Vice-President; T. J. Milner, Manager; I. A. Nadeau, Secretary; T. H. Tyndale, Treasurer; I. A. Nadeau, Assistant Treasurer.

*Sioux Falls, De Smet & Northern.*—J. H. Carroll, of De Smet, Dak., is President of this company, and M. S. Parker, of Winona, Minn., is Chief Engineer.

*Tabor & Northern.*—At the annual meeting in Tabor, Ia. Oct. 22, the following officers were re-elected: T. McClelland, President; Merrill Otis, Vice-President; A. T. West, Secretary; J. E. Todd, Treasurer; A. S. Prouty, Auditor.

*Union Pacific.*—William H. Holcomb has been chosen a director in place of Colgate Hoyt, resigned, and has also been chosen Vice-President to succeed the late Thomas J. Potter as chief executive officer, with headquarters at Omaha. T. L. Kimball has been chosen General Manager and C. S. Mellen, Assistant General Manager.

*Union Palace Car Co.*—The following are the directors of this new company, which include the Mann Boudoir and Woodruff Sleeping Car companies: Thomas C. Purdy, President; D. C. Corbin, Vice-President; E. D. Adams, John H. Inman, James A. Garland, John Greenough, Job H. Jackson and John G. Moore.

*Western Maryland.*—At the annual meeting in Baltimore the Board of Directors re-elected J. M. Hood President and General Manager and John S. Harden Secretary and Treasurer.

## OLD AND NEW ROADS.

**Anniston & Cincinnati.**—The tunnel in the Calone Mountains, near Gadsden, Ala., has been completed, and trains are now running without transfer from Anniston through Alexandria and Gadsden to Atalla, Ala., a distance of about 36 miles.

**Atchison, Topeka & Santa Fe.**—The extension of the Chicago, Kansas & Western from Concordia, Kan., northwest to Superior, Neb., a distance of 38 miles, has recently been placed in operation. Besides this new line the company has also built the following new mileage this year. The Southern Kansas extended from Frontenac, Kan., three miles; Southern Kansas & Panhandle, extended five miles, and the Southern Kansas of Texas extended four miles, a total of 50 miles added to the mileage of the Atchison, Topeka & Santa Fe proper this year.

**Atlanta, Atlantic & Western.**—There are two corps of surveyors in the field, one working on a permanent location of the line from Atlanta to Eatonton, and the other from Eatonton to Savannah. Seven miles of the line east from Atlanta, has been permanently located and right of way is being secured by purchase and condemnation.

**Austin & Northwestern.**—The company will, it is reported, soon issue bonds to the amount of $125,000 to complete the extension from Burnet to Marble Falls, Tex., 17 miles.

**Baltimore & Ohio.**—The Berkeley Springs & Potomac road, extending from Hancock, Md., to Berkeley Springs, W. Va., a distance of 6 miles, has been completed and was opened for traffic Nov. 1. C. D. Langhorne, of Richmond, Va., was the contractor, and Charles Goldsborough the engineer in charge.

**Burlington & Missouri River.**—The Supreme Court of Nebraska last week handed down a decision in favor of the company in the case regarding the consolidation with the Chicago, Burlington & Quincy. The suit was originally brought by the Attorney-General, in the name of the state, asking by what authority the Chicago, Burlington & Quincy road operated the Burlington & Missouri in the state, while it was not incorporated under the laws of Nebraska, or else that the Burlington & Missouri be operated as an independent organization. The decision of the Supreme Court was to the effect that the former road need not incorporate in Nebraska, and the result will be that the consolidation with the Burlington & Missouri, made in 1880, will now be effective, and do away with the separate existence of the two roads. The attempt was to make the Chicago, Burlington & Quincy proper amenable to the laws of Nebraska.

**Cape Fear & Yadkin Valley.**—On the extension to Wilmington, N. C., about 14 miles of track between the Northeastern and Black rivers have been graded.

**Carolina, Cumberland Gap & Chicago.**—Col. James G. Gibbs has completed the preliminary survey from Asheville, N. C., to Pickens C. H. The distance from Aiken, the southern terminus, to Pickens, is 130 miles, and of this about 60 miles are graded, and tracklaying is completed on the 25 miles from Aiken to Edgefield. The maximum grade across the mountains to Asheville, N. C., is 80 ft. to the mile. It is estimated that this section can be finished for about $28,452 per mile and the French Broad section for about $8,000, or an average of about $18,000 from Pickens C. H., to Asheville. The distance from Aiken to Asheville is 175 miles.

**Central of Georgia.**—The surveys for the new line from Eden eastward 150 miles to Americus, Ga., have now been nearly completed, and it is expected that the contracts for building the entire line will be let this month. The line will give the Central of Georgia almost an air line from Birmingham to Savannah.

**Chattanooga, Cleveland & Murphy.**—At an election held in Cleveland, Tenn., Oct. 25, it was decided by a vote of 466 to 10 to issue $50,000 of the bonds to aid in the construction of this new road, surveyed and practically located from Chattanooga, Tenn., via Cleveland to Murphy, Cherokee County, N. C. This company is incorporated in North Carolina as the Hiawassee Railroad, to which Cherokee County has already voted a subscription of $50,000 in bonds. This road is 94 miles in length, and will run through a rich mineral and timber section, touching a territory largely undeveloped and without railroad facilities. Prospects are exceedingly bright, and work is expected to begin by Jan. 1, 1889.

**Columbia Central.**—The Commissioners of the District of Columbia have returned with their disapproval the bill to incorporate this company, which was organized to build a road from a point in Anne Arundel County, Md., to the city of Washington.

**Columbia & Northern.**—The preliminary survey for this road from Columbia via Newark and Foreman to Milnor, Dak., has been completed, and much local aid has been secured. It is expected that work will begin next year. The proposed route is over a very level country, and but little grading will be required.

**Cordele, Waynesville & South Brunswick.**—The company has been organized to build a road from Cordele to Waynesville, Ga., by M. P. King, H. R. Symons and others, of Brunswick, Ga. A charter will be applied for this winter.

**Covington & Macon.**—The right of way controversy at Athens, Ga., has been settled, and the work on the road will be pushed rapidly to completion. All injunction cases have been withdrawn.

**Deadwood Central.**—The preliminary survey for the first 50 miles of the road is now being made. The map of the first eight miles, from Deadwood, Dak., to Ruby Basin, has been filed at Washington, and it is expected that tracklaying will begin on this part of the road this month. The line runs through a mountainous country with maximum grades of 65 ft. per mile and 20 deg. curvature. The ore traffic and coal carrying and supplies to the mines will form the chief business of the line.

**Duluth, Wilmar & Sioux Falls.**—The last rail on this road was laid near Sioux Falls, Dak., Oct. 25, and regular trains will commence running this week. Shepard, Winston & Co., of St. Paul, were the contractors. The line is an extension of the St. Paul, Minneapolis & Manitoba, and extends from Wilmar, Minn., to Sioux Falls, a distance of 150 miles.

**East Chicago, Kensington & Lamont.**—Incorporated in Illinois to build a road from the town of Thornton, on the state line between Indiana and Illinois, thence in a northwesterly direction to Kensington, in Hyde Park; thence southwesterly through Cook and Will counties to a point on the Kankakee River between Kankakee and Grundy counties. The capital stock is $2,000,000.

**Fitchburg.**—At a meeting of the directors last week it was voted not to declare the usual dividend. From as far

back as 1859 the road has always paid dividends, and as high as nine per cent.

The non-dividend paying common stock is $7,000,000, held by the state of Massachusetts. The preferred stock, which received 2 per cent. the first half of this year and now receives nothing from the second half, amounts to $12,437,800. The gross earnings in 1887 were $4,569,321, and the net earnings, $1,086,667. The charges and the dividends paid last year were $127,658 in excess of the net revenue. The financial statement for this year is not yet made up and the net decrease cannot be stated. The gross earnings on the entire system will, however, show an increase of about $30,000, as compared with those of last year. Low rates were the principal cause of the loss in net receipts.

**Georgia & Alabama Midland.**—The contracts with the Plant Investment Co., of Connecticut, the Savannah, Florida & Western Railroad, of Florida; the Southern Express Co., and the Alabama Improvement & Terminal Co., were ratified and approved at a recent meeting of the stockholders.

**Georgia, Carolina & Northern.**—The tracklaying from the Catawba River to Chester, S. C., was finished Oct. 24, completing the road from Monroe, N. C., to Chester, S. C., 45 miles. Thirty miles of this road lies in South Carolina. The principal contractors were Wright & Co., of Richmond, Va.; Rice & Coleman, of Laurens, S. C.; Stuart, Sullivan & Co., and R. Hally Norton. The line has been surveyed to Atlanta, Ga., 220 miles from Chester, and it is thought that work will soon be commenced on a section of this line.

**Georgia Pacific.**—About 100 miles of grading is completed on the extension between Columbus and Johnsonville, Miss., a total distance of 142 miles. Tracklaying has been commenced and seven miles have been laid from Columbus, and also five miles west from West Point. The company expect to have all the grading finished and 40 miles of track completed by Jan. 1. The principal contractors are J. S. McTighe & Co., of Memphis, Tenn.; McLaughlin Bros., of Somerville, Ga.; Dunn Bros., Gibson & Corpening and Jas. Sullivan & Son, of Memphis.

**Louisville, New Albany & Chicago.**—The company has secured a right of way from Howland's Station to the Indianapolis Belt road, giving it a new entrance to Indianapolis.

**Louisville Southern.**—The shops of this road will be removed at once from Louisville, Ky., to Harrodsburg, Mercer County, Ky. Ten thousand dollars will be expended on new buildings.

**Marietta & North Georgia.**—The company has at present two parties of engineers locating the extension from near Blue Ridge to the Hiawasse River, to connect with the Knoxville Southern near the Tennessee state line. The distance is about 40 miles, and the location will be completed within 30 days. Between Marietta and Canton 5½ miles of road are being rebuilt, and it will be completed next week. Livingston & Hall are the contractors. The section of road from Marietta to Canton was built ten or twelve years ago for a narrow gauge road with sharp curves and heavy grades, and as the company will change to standard gauge this fall a large portion of that section had to be rebuilt. The firm of London bankers, C. J. Hambro & Sons, who undertook to place about $1,000,000 of the bonds of this company, have succeeded in doing so. The price is said to have been par. These bonds were all that remained unsold of the amount authorized to finish the entire line between Atlanta and Knoxville.

**Memphis, Tuscaloosa & Atlantic.**—The surveyors will probably finish running the preliminary line from Tuscaloosa, Ala., to Memphis, Tenn., within two weeks. The locating survey has been made between Tuscaloosa and Oxford, Miss.

**Montana Central.**—The Wickes tunnel has been completed and a train passed through it Oct. 24. The tunnel is 18 miles from Helena, on the branch to Butte, and runs through a large mountain of the Boulder divide. It is 6,200 ft. long, being the longest in Montana. Its construction cost about $1,500,000. Work was commenced in May, 1887, and it was pierced through last September. It was constructed by Larson & Keefe, of Helena, Mont.

**New Roads.**—Application has been made at Ottawa for a charter for a railroad to Morrisburg and thence to some point across the St. Lawrence River into New York State.

**New Westminster, Bellingham Bay & Seattle.**—The contract for clearing and grading the road from New Westminster to the international boundary line has been let to James Leary, of New Westminster, and he has cleared all this part of the road and commenced grading. The contract for clearing and grading from the boundary line to Bellingham Bay will be made at once. The road is to be built from New Westminster, along Bellingham Bay and through Whatcom to Seattle, Wash. Ter. The preliminary surveys have all been made, and the locating survey is finished between New Westminster and Bellingham Bay. It is expected to have the line completed from New Westminster to Bellingham Bay early next year, and the remainder during the following year.

**Northern Michigan.**—The preliminary survey for this road has now been completed for over ten miles from Houghton, and is progressing at the rate of a mile a day. It will probably be completed the entire distance between Houghton and Watersmeet, 70 miles, in about three months, and contracts for building the line will be let next April. The road will run southwest from Houghton to a junction with the Ontonagon and Brule River road, at a point about five miles east of Rockland, Mich., then south in as direct a line as possible to Watersmeet.

**Ohio Valley.**—This company has given a mortgage to the Central Trust Co. of New York, for $1,960,000, to secure an issue of bonds of like amount. It is a general consolidated and first mortgage on 98 miles of road, and is issued at the rate of $20,000 per mile.

**Oregon Pacific.**—The track has reached the town of Mehama, Or., and construction trains will be run to that point from Albany. It is expected to have the road completed to Brightenbush, 60 miles east of Albany, before winter.

**Oregon & Washington Territory.**—Grading and tracklaying have been completed on that part of the road between Wallula and Walla Walla, Wash. Ter., a distance of 53 miles. Extensions and branches have also been built between Waterman's and Centreville, Ore., and from a point on the line between Wallula and Walla Walla and Fulton, Ore., 15 miles. The branch from Eureka Flat Junction to the head of Eureka Flat will soon be completed. It is 20 miles long. G. W. Hunt, of Portland, Ore., was the contractor and Frank Riffle, of Wallula is the chief engineer.

**Perry & Maysville.**—Articles of incorporation have been filed in Illinois to build a road from Maysville to Perry, in Pike County. The capital stock is $75,000 and the principal office is to be at Perry.

**St. Louis, Arkansas & Texas.**—The extension from Malden to Delta, Mo., has been completed, and trains will soon be running into St. Louis, the tracks of the St. Louis, Iron Mountain & Southern being used from Delta to St. Louis.

**St. Louis, Iron Mountain & Southern.**—Work has been resumed on the extension from Fort Smith to Greenwood, Ark., 18 miles. The contractors are McCarthy, Kerrigan & Co., of Little Rock, Ark. It is reported that this firm has also received the contract for building the extension of the Benton branch to Hot Springs.

**San Francisco, Clear Lake & Humboldt.**—It is reported that the Southern Pacific has secured the charter, right of way, etc., of this road, which was projected to extend from Napa City to Clear Lake, Cal., 75 miles. General John McNulta was interested in the company. It is now stated that the Southern Pacific will build the road commencing at Rutherford, a point in the Napa Valley between Napa City and Calistoga.

**San Francisco & North Pacific.**—The company has arranged with Seligman Bros., of New York, for placing enough bonds to finish the Marin and Napa branch and the Cloverdale & Ukiah extension. Col. Donahue, the President, has increased his holdings, so that he now owns nearly all the stock.

On the latter line the grading is now completed on the 28 miles between Cloverdale & Ukiah, and on the Marin & Napa tracklaying is finished to Sears Point, on the Sonoma Valley road, seven miles from Ignacio, on the San Francisco & North Pacific.

**Seattle, Lake Short & Eastern.**—Tracklaying on the Northern branch has been completed beyond Snohomish River to a point 17 miles north of Snohomish Junction, and the grading has been finished for 7 miles. On the main line east from Seattle the road is completed to Raging River, a distance of 49 miles, and grading is in progress on an 11 mile section east from Raging River. Ten miles of track has been laid on the division west from Spokane Falls toward Davenport, W. T., and it is expected to have 45 miles completed by Dec. 1.

The following are the contractors on the line: Burns & Chapman, of Spokane Falls, Wath. Ter., for 45 miles west from Spokane Falls; Smith & Burns from 50th to 60th mile from Seattle; Earl & MacLeod from Snohomish north.

**Southern Pacific.**—The company has filed at San Francisco a deed of trust to the Central Trust Co., of New York, conveying to the latter, for the purpose of securing payment of mortgage of $38,000,000, all the property of the railroad company and also the property of branch roads which have been amalgamated with it, and turned over all their property to the Southern Pacific, the latter assuming all debts and liabilities. To secure payment of these debts, the Southern Pacific will issue $38,000,000 bonds, and to secure these bonds the company will create a sinking fund, and after the year 1898 will pay $20,000 per month out of the net income of the railroad and continue until the debt is paid.

**South Pennsylvania.**—The stockholders who have assented to the plan of reorganization formed by Andrew Carnegie are, according to the New York *Times*, as follows: Daniel Hostetter, Henry Phipps, Jr., D. O. Mills, W. C. Whitney, H F. Dimock, O. H. Paine, Franklin B. Gowen, C. H. Borie, E C. Knight, F. D. Lewis, J. D. Rockefeller, W. Rockefeller, E. E. Wicks, J. B. Lippincott, Trustee J. B. Colgate, A. J. Stewart and J. A. Kane, by attorney. The principal ones who have not assented to the plan are, according to the same authority: Ralph Bagley, B. F. Jones, A. C. Frick, M. Watson, John Chalfant, H. S. McKee and E. M. Ferguson.

**Talladega & Coosa Valley.**—It is reported that the company will this Fall widen its gauge to standard and also build an extension from Talladega to a connection with the East Alabama. The road is in operation between Talladega and Pell City, Ala., 25 miles.

**Texas & Pacific.**—It is stated that arrangements will be made for the discharge of the receiver and the closing up of the reorganization at the meeting of the directors on Nov. 15. The business of the company in the present fiscal year has been even better than was expected. Full interest on the first mortgage bonds has been earned, and will be paid when it becomes due on Dec. 1, and in addition about $500,000 has been taken from net earnings and invested in betterments and improvements to the road. The prospects for winter business are excellent.

**Tiffin & Fremont.**—A company has been organized under this name at Tiffin, O., to build a railroad 65 miles long from Lakeside to Upper Sandusky via Tiffin and Fremont.

**Turtle Creek Valley.**—The Pennsylvania has absorbed this road, which was built by George Westinghouse, Jr., to natural gas wells. By extending it northward from Port Perry, on the Baltimore & Ohio, to Saltsburg, Pa., on the Pennsylvania, near Punxsutawney, the southern terminus of the Buffalo, Rochester & Pittsburgh, a competing line to the Pennsylvania to points in New York would be formed. Twenty-two miles of the road are completed, and $100,000 of the $500,000 capital has been expended on it. The Pennsylvania has reorganized the board of directors by electing Vice-President J. N. Dubarry of the Pennsylvania as its President, and stopped all work.

**Union Pacific.**—Tracklaying on the branch extending from Waldo to Colby, Kan., a distance of 132 miles, has been completed, and the line will be opened for business in a few days.

**Union Palace Car Company.**—Prominent capitalists, whose names appear in another column, have formed a company with the above name, which has absorbed the Mann Boudoir and Woodruff Sleeping Car companies.

The Wilmington (Del.) *Evening Journal* of Oct. 25 gives the following particulars concerning the new organization: "The capital will be $3,000,000. The combination of these two companies is largely due to the efforts of Job H. Jackson, of the Jackson & Sharp Co., car builders, of this city. Both the Jackson & Sharp Co. and the Harlan & Hollingsworth Co. have built many cars for the two companies mentioned, taking in part payment stock of the debtor companies, until now they own a controlling interest in the capital stock of the two parlor car companies. The organization of the new company has been contemplated for some months. Early this month Job H. Jackson, who had been intrusted with the Wilmington holdings, visited New York and effected the organization of the new company. A majority interest in the Wilmington holdings was transferred to New York parties, who, through Thomas C. Purdy and John G. Moore, invested $1,500,000 in the company. The Wilmington car companies have made contracts with the new company for 34 parlor cars. These two companies will have the exclusive work of building and repairing cars for the Union Company. The new company has secured a contract for the exclusive use of its cars on the railroad lines controlled by the Richmond & West Point Terminal Company, estimated to be over 4,000 miles in length. It is stated that the company will soon conclude a similar contract with the Central of New Jersey and the Philadelphia & Reading. The Mann Company already controls the parlor car service of six or seven important lines of railroads, and the Woodruff Company controls some lines in the East."

The Mann Company now operates between Chicago and Minneapolis over the Chicago, St. Paul & Kansas City; between Atlanta and Birmingham over the Georgia Pacific; and over several long routes on the Cincinnati, New Orleans & Texas Pacific and its connections. The most important of these are the Cincinnati-New Orleans and the St. Louis-New Orleans lines, the latter running over the Mobile & Ohio. Others run to Chattanooga, Atlanta, Knoxville, Shreveport and Louisville. The Woodruff Company operates over the Long Island, Manhattan Beach, Grand Rapids & Indiana, Chicago & Eastern Illinois, Evansville & Terre Haute, Ohio, Indiana & Western, Cincinnati, Jackson & Mackinaw, Memphis & Little Rock, Central of New Jersey, Philadelphia & Reading, Camden & Atlantic and portions of other roads.

**Vancouver, Klickitat & Yakima.**—Grading has been resumed on this road after a suspension of about two months. The road is to be built from Vancouver, Wash. Ter. through Klickitat Pass in the Cascade Mountains to a connection with the Northern Pacific. The first six miles from Vancouver have already been completed.

## TRAFFIC AND EARNINGS.

### Traffic Notes.

The Wisconsin Central now issues 5,000 mile tickets, and will join the roads, most of which are east of Chicago, which mutually agree to honor these mileage tickets of each other. The Travelers' Protective Association, an organization of commercial travelers, is urging all the prominent western roads to join in this movement.

The agreement to transport live stock by actual weight instead of at car-load rates, which has been under discussion for some time, was not put in operation at Kansas City and St. Louis on Oct. 25, as had been expected, and the Chicago roads held a meeting this week to consider the matter; but as the weighing system had been begun and was operating satisfactorily there it was decided that it should be continued, notwithstanding the delay at southwestern points.

The Chicago, Milwaukee & St. Paul and the Union Pacific have put on a line of through sleeping cars between Chicago and Denver via Omaha.

The Chicago & Northwestern has suspended its notice of last week that it would reduce through rates between Duluth and seaboard points to the basis of $1.10 to meet the new rates of the Duluth, South Shore & Atlantic. It is stated that this action is the result of pressure by the other St. Paul roads, and that it operates to postpone a cut until a conference can be held.

Inquiry was made at Buffalo last week for rates on wheat by water from Buffalo to Chicago.

General passenger agents, representing the Illinois Central, Mobile & Ohio, Texas & Pacific, Atlantic & Pacific, Louisville, New Orleans & Texas Pacific, and the Louisville & Nashville roads, met in Louisville this week to make arrangements for furthering a European emigrant business. The project is for the West India and Pacific Steamship Company to run steamers between Liverpool and New Orleans weekly.

The International Railway Association has agreed upon a number of rules in connection with competitive traffic in its territory. The rate on cattle from common points in Texas to Shreveport will, on Nov. 5, be made $50 per standard car. In the passenger department the rate on 1,000-mile tickets has been fixed at 2½ cents a mile, tickets limited to six months from date of issue.

### The Inter-state Commerce Commission.

The Commission published on Oct. 26 the result of its examination of the new transcontinental tariffs which were put in effect Sept. 1. After stating the point of the former decision in the Denver case, that rates from San Francisco to Denver higher than those from San Francisco to Kansas City are not permissible under the short-haul clause of the law, and showing that the new tariffs are clearly made in pursuance of an honest effort to conform to the provisions of the act as interpreted by the Commission, the opinion proceeds to examine the details of the new system, which were not known to the Commission until after they were put in force. The difficulties which rose at Chicago, St. Louis and other interior points from which rates were established to the Pacific coast higher than the rates from New York City are explained to have arisen from a series of commodity tariffs which named articles on which low rates were made from specified points, leaving all other articles and points subject to the class rates under the Western classification. In respect to these special tariffs the commission rules as follows:

Rates that are just and reasonable from selected manufacturing points through the entire territory east of the Missouri River and west of the Atlantic seaboard, are prima facie just and reasonable from all other points in the same territory.

A tariff naming a rate from one locality lower than that enjoyed by its neighbor, when the circumstances are the same, tenders a preference or advantage to the first, and when any shipper is damaged by the exaction of any additional burden the preference becomes undue and unreasonable unless it can be justified upon some sound and substantial ground.

Common carriers are under obligations to take all descriptions of ordinary traffic from all points, and it is right that the rates should be known and announced publicly in advance of the offering of traffic.

Under the act to regulate commerce, shippers are not to be put in a position of subserviency to common carriers nor required to ask for rates, but are entitled to equal and open rates at all times.

Discriminations are made and undue advantages are given by the special tariffs in question in giving different rates to places named and those not named; to manufactured articles named and those not named; to jobbers at places named and those not named; to manufacturers and jobbers and other dealers.

The opinion further states that these conclusions were made known on Oct. 16 to representatives of the transcontinental lines at an interview arranged for that purpose and were at once acceded to, the modified arrangement suggested by the commission as to west-bound business having gone into effect on Oct. 23.

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The firm of Coxe Brothers & Co., of Philadelphia, anthracite coal shippers, whose shipments amount to a million and a half of tons annually, have, through their attorney, Franklin B. Gowen, filed with the Commission a complaint against the Lehigh Valley, alleging that the road discriminates against the firm and other shippers in favor of the Lehigh Valley Coal Company. The complainant avers that the railroad is virtually a coal producer, the control of the Coal Company being owned by it, and that it charges higher rates per ton per mile to other producers than upon coal of its own. The complaint is understood to be based on

a comparison of the rates charged for carrying anthracite from Drifton, Pa., to Perth Amboy, N. J., 130 miles, and on bituminous from the Snow Shoe mines to Perth Amboy, 295 miles. In the longer haul the proportion accruing to the Lehigh Valley road is less than the amount received over the same road for shipments made over the shorter distance.

A letter has been sent by the Commission to the railroad and telegraph companies affected by the act placing the telegraph lines of the railroad which received Government aid under the control of the Commission, calling their attention to the fact that they have not filed with the Commission copies of contracts and certain other information relative to the use of these telegraph lines, as required by the law.

### Demurrage Agreement of the Southern Railway & Steamship Association.

The following rules for the collection of demurrage and storage are announced by Commissioner T. H. Carter, having been unanimously adopted by the Rate Committee, Oct. 19, to take effect at association points Nov. 1, 1888.

"All package freight, which is not removed by the owners from the custody of the railroad company within seventy-two hours, not including Sundays, computed from 10 o'clock A. M. of the day following the day of arrival, shall be subjected thereafter to a charge for storage for each day, or fraction of a day, that it may remain in the custody of the railroad company as follows: L. C. L. shipments, 1c. per 100 pounds per day; no charge less than 10c. C. L. lots, 6c. per ton of 2,000 pounds per day; the right being reserved to store such property in a public warehouse at the risk and expense of the owners.

"Bulk meat, bulk grain, hay, cotton-seed, lumber, lime, coal, sand, brick, wood, and such other freight as is loaded and unloaded by shippers, which is not unloaded from cars within time specified above, shall be subject to a charge of 50c. per car, per day, for demurrage; and this provision shall not be evaded by the transfer of ownership made within its limit.

"Where such freight is placed for delivery, and owners fail to unload within the time specified herein, and thereafter refuse to pay the demurrage, the railroads shall refuse to place any car or cars for such party or parties until they pay the demurrage on car or cars delivered, and agree to promptly pay such charges as may accrue in future.

"Where cars are turned over to a connecting road for delivery on its tracks, or private tracks, it shall be the duty of delivering road to collect demurrage charges, as above provided for, and report the amount so collected to the road by which the car arrived. The road delivering the car to connection must give notice of the day such car was received.

"It shall be the duty of the Commissioner, through his inspectors, to see that these rules are strictly enforced, and any violation thereof shall subject the road guilty of such violation to the penalties provided by the contract of this association for the non-maintenance of rates."

Agents will be governed accordingly, making reports of all collections on account of demurrage to their car mileage department.

### Chicago Trackage Bureau.

The above is the name of the organization formed at Chicago last week for the purpose of collecting pay for detention of freight cars. The Executive Committee of the Association consists of W. W. Peabody, General Manager Baltimore & Ohio, Chairman; C. H. Chappell, General Manager Chicago & Alton; J. M. Whitman, General Manager Chicago & Northwestern; E. St. John, General Manager Chicago, Rock Island & Pacific, and John Newell, President Lake Shore & Michigan Southern. E. D. Moore, late Chairman of the Western Classification Committee, has been appointed Superintendent of the Association. A committee of three has been appointed to prepare a form of joint letter to be issued by the Chairman in the name of all the roads in the Association, giving the public notice as to the proposed trackage charges.

### East-bound Shipments.

The shipments of east-bound freight from Chicago by all the lines for the week ending Saturday, Oct. 27, amounted to 56,088 tons, against 64,070 tons during the preceding week, a decrease of 7,982 tons, and against 48,184 tons during the corresponding week of 1887, an increase of 7,904 tons. This includes flour, grain, seeds, provisions, dressed beef, hides, wool and lumber. The proportions were:

| | W'k to Oct. 27. | | W'k to Oct. 20. | |
|---|---|---|---|---|
| | Tons. | P. c. | Tons. | P. c. |
| Wabash | 4,834 | 8.6 | 5,802 | 9.0 |
| Michigan Central | 5,615 | 10.0 | 6,461 | 10.1 |
| Lake Shore & Mich. So. | 8,393 | 15.0 | 9,486 | 14.8 |
| Pittsburgh, Ft. W. & Chicago | 7,860 | 14.0 | 9,598 | 15.0 |
| Chicago, St. L. & Pittsburgh | 9,060 | 16.2 | 8,780 | 13.7 |
| Baltimore & Ohio | 2,015 | 3.6 | 2,799 | 4.4 |
| Chicago & Grand Trunk | 7,926 | 14.1 | 9,086 | 14.2 |
| N. Y., Chicago & St. Louis | 4,319 | 7.7 | 4,620 | 7.2 |
| Chicago & Atlantic | 6,066 | 10.8 | 7,438 | 11.6 |
| Total | 56,088 | 100.0 | 64,070 | 100.0 |

Of the above shipments 3,922 tons were flour, 21,020 tons grain, 2,529 tons cured meats, 2,198 tons lard, 7,855 tons dressed meats, 723 tons butter, 1,495 tons hides, 346 tons wool, and 3,484 tons lumber.

The two Pennsylvania lines carried 30.2 per cent, of all the business, while the three Vanderbilt lines carried 32.7 per cent.

### Cotton.

The cotton movement for the week ending Oct. 26 is reported as follows, in bales:

| | 1888. | 1887. | Inc. or Dec. | P. c. |
|---|---|---|---|---|
| *Interior markets:* | | | | |
| Receipts | 179,749 | 192,049 | D. 12,300 | 6.4 |
| Shipments | 156,340 | 152,996 | I. 3,344 | 2.2 |
| Stock | 198,380 | 268,753 | D. 70,373 | 26.2 |
| *Seaports:* | | | | |
| Receipts | 270,707 | 294,934 | D. 24,227 | 8.2 |
| Exports | 162,085 | 217,919 | D. 55,834 | 25.6 |
| Stock | 571,654 | 623,712 | D. 52,058 | 8.3 |

### Coal.

The coal and coke tonnage of the Pennsylvania originating on lines east of Pittsburgh and Erie for the week ending Oct. 20, and the year to that date, was as follows:

| | Coal. | Coke. | Total. |
|---|---|---|---|
| Total for week ending Oct. 20 | 220,490 | 86,194 | 306,684 |
| Total for year 1888 to date | 9,321,912 | 3,178,780 | 12,500,692 |
| Total for year 1887 to date | 8,212,114 | 2,871,123 | 11,083,237 |

The anthracite coal tonnage of the Belvidere division of the United Railroads of New Jersey division for the same periods was as follows:

| | 1888. | 1887. | Inc. |
|---|---|---|---|
| Total for week, Oct. 20 | 45,186 | 22,082 | 23,104 |
| Total for year | 1,322,179 | 1,269,342 | 52,837 |

The Cumberland coal trade for the week ending Oct. 30 amounted to 78,866 tons, and for the year to that date 2,946,815 tons.

The coal tonnage for the week ending Oct. 27 is reported as follows, in tons:

| | 1888. | 1887. | Increase. | P. c. |
|---|---|---|---|---|
| Anthracite | 886,469 | 747,545 | 38,922 | 5.2 |
| Bituminous | 328,885 | 326,840 | 2,045 | 0.6 |

### Railroad Earnings.

Following is the statement of the earnings of the Philadelphia & Reading, and the Philadelphia & Reading Coal & Iron Co. for the month of September:

| | 1888. | 1887. | Dec. |
|---|---|---|---|
| *Philadelphia & Reading:* | | | |
| Gross earnings | $1,932,783 | $1,968,612 | $35,826 |
| Net earnings | 975,221 | 1,055,624 | 80,403 |
| *Philadelphia & Reading Coal & Iron Co.:* | | | |
| Gross earnings | 2,025,681 | 2,135,081 | 109,400 |
| Net earnings | def. 40,520 | 207,310 | 247,830 |
| Total both co's | $3,958,464 | $4,103,693 | $145,228 |
| Net | 934,701 | 1,262,934 | 328,233 |

The statement of the Denver, South Park & Pacific Division of the Union Pacific, for the month of August and the eight months ending Aug. 31 is as follows:

| | 1888. | 1887. | Inc. or Dec. |
|---|---|---|---|
| *Month of August:* | | | |
| Gross earnings | $105,137 | $131,856 | D. $26,719 |
| Oper. expenses | 95,276 | 94,175 | I. 1,101 |
| Net earnings | $9,861 | $37,681 | D. $25,618 |
| *Jan. 1 to Aug. 31:* | | | |
| Gross earnings | $725,553 | $852,030 | D. $126,477 |
| Oper. expenses | 690,223 | 797,306 | D. 46,423 |
| Net earnings | $35,330 | $54,724 | D. $80,054 |

The following is the statement of the Allegheny Valley for the month of September and the nine months ending Sept. 30:

| | 1888. | 1887. | Inc. or Dec. |
|---|---|---|---|
| *Month of September:* | | | |
| Gross earnings | $188,021 | $180,959 | I. $7,062 |
| Oper. expenses | 94,240 | 109,190 | D. 14,950 |
| Net earnings | $93,781 | $71,769 | I. $22,012 |
| *Nine Months ending Sept. 30:* | | | |
| Gross earnings | $1,515,685 | $1,483,551 | I. $32,134 |
| Oper. expenses | 894,263 | 928,894 | D. 34,631 |
| Net earnings | $621,421 | $554,657 | I. $66,764 |

The following is the statement of the Oregon Short Line for the month of August and the eight months ending Aug. 31:

| | 1888. | 1887. | Increase. |
|---|---|---|---|
| *Month of August:* | | | |
| Gross earnings | $253,005 | $195,654 | $57,351 |
| Oper. expenses | 120,838 | 105,497 | 15,341 |
| Net earnings | $132,167 | $90,157 | $42,010 |
| *Jan. 1 to Aug. 31:* | | | |
| Gross earnings | $1,650,878 | $1,292,335 | $358,543 |
| Oper. expenses | 909,923 | 871,064 | 38,859 |
| Net earnings | $740,955 | $421,271 | $319,684 |

The statement of the New York Central & Hudson River for the month of September, the quarter ending Sept. 30, and the nine months ending Sept. 30, is reported as follows:

| | 1888. | 1887. | Inc. or Dec. |
|---|---|---|---|
| *September:* | | | |
| Gross earnings | $3,366,100 | $3,438,555 | $72,455 |
| *Quarter ending Sept. 30:* | | | |
| Gross earnings | $9,490,062 | $9,550,074 | $60,012 |
| *Year ending Sept. 30:* | | | |
| Gross earnings | $36,132,920 | $35,297,056 | $835,864 |

The statement of the Mexican Central for the month of August and the eight months ending Aug. 31 is reported as follows:

| | 1888. | 1887. | Increase. |
|---|---|---|---|
| *Month of August:* | | | |
| Gross earnings | $453,785 | $374,116 | $79,669 |
| Oper. expenses | 273,139 | 219,504 | 53,635 |
| Net earnings | $180,646 | $154,612 | $26,034 |
| *Eight Months ending Aug. 31:* | | | |
| Gross earnings | $3,821,515 | $2,066,273 | $755,242 |
| Oper. expenses | 2,357,292 | 1,714,701 | 642,591 |
| Net earnings | $1,464,223 | $1,351,572 | $112,651 |

Guadalajara Division.—March 20 to Aug. 31.

| | |
|---|---|
| Gross earnings | $44,845 |
| Oper. expenses | 21,159 |
| Net earnings | $23,686 |
| | $191,448 |
| | 93,327 |
| | $98,121 |

The Prescott & Arizona Central's statement for the month of September and the nine months ending Sept. 30 is as stated below:

| | 1888. | 1887. | Increase. |
|---|---|---|---|
| *Month of September:* | | | |
| Gross earnings | $10,137 | $6,831 | $3,306 |
| Oper. expenses | 3,746 | 3,049 | 697 |
| Net earnings | $6,391 | $3,782 | $2,609 |
| *Jan. 1 to Sept. 30:* | | | |
| Gross earnings | $90,936 | $66,935 | $24,001 |
| Oper. expenses | 29,257 | 27,445 | 1,812 |
| Net earnings | $61,679 | $39,490 | $22,189 |

UNION PACIFIC.

The results of the first six months of the current year to June 30, 1888, as compared with the corresponding period of 1887, is shown by the following table:

| *Income:* | 1888. | 1887. | Inc. or Dec. |
|---|---|---|---|
| Earnings, entire system | $13,493,580 | $13,021,892 | I. $471,688 |
| Expenses, entire system | 8,526,195 | 8,338,920 | I. 187,275 |
| Taxes, entire system | 552,000 | 537,390 | I. 14,610 |
| Total expepenses and taxes | $9,078,195 | $8,876,310 | I. $201,825 |
| Surplus earnings | 4,415,386 | 4,145,582 | I. 269,803 |
| From investment outside of the system | $363,994 | $316,116 | I. 47,878 |
| Miscellaneous land sales | 11,968 | 14,095 | D. 2,127 |
| Profits on investments, premiums, etc | ..... | 15,045 | D. 15,045 |
| From trustees K. P. Con. mortgage | ..... | 10,410 | D. 10,410 |
| Total income | $4,791,347 | $4,501,248 | I. $290,100 |
| *Expenditures:* | | | |
| Interest on bonds | $2,546,686 | 2,603,768 | D. $57,082 |
| Discount and interest, premiums, etc | 92,032 | 110,870 | D. 18,838 |
| Sinking fund requirements, company's bonds | 340,285 | 332,720 | I. 7,565 |
| Interests on bonds of operated roads | 675,215 | 665,600 | I. 9,615 |
| Land taxes and land expenses, Union Division | 18,806 | 24,250 | D. 5,444 |
| Profit and loss | 27,150 | 34,817 | D. 7,667 |
| Total | $3,700,175 | $3,772,026 | D. $71,851 |
| Surplus to this point | 1,091,173 | 729,222 | I. 361,951 |
| Less requirements, approximate | 347,000 | 335,856 | I. 11,144 |
| Surplus income | $744,173 | $393,366 | I. $350,807 |

The statement of earnings and expenses of the Norfolk & Western for September and the nine months to Sept. 30 is as follows:

| | 1888. | 1887. | Inc. or Dec. | P.c. |
|---|---|---|---|---|
| *September:* | | | | |
| Pass., Mail and exp. | $93,884 | $83,417 | I. $10,467 | 13 |
| Freight | 336,326 | 321,308 | I. 15,018 | 5 |
| Gross earnings | $430,211 | $404,725 | I. $25,486 | 6 |
| Expenses and taxes | 262,477 | 218,419 | I. 44,058 | 20 |
| Net earnings | $167,733 | $186,306 | D. $18,572 | 10 |
| P. c. of ex. to gr. earn. | 61 | 54 | | |
| *Nine Months—Jan. 1 to Sept. 30:* | | | | |
| | 1888. | 1887. | Inc. | P.c. |
| Pass., mail and exp. | $733,698 | $583,082 | $150,616 | 26 |
| Freight | 2,800,701 | 2,421,221 | 439,480 | 18 |
| Gross earnings | $3,594,399 | $3,004,303 | $590,096 | 20 |
| Expenses and taxes | 2,195,845 | 1,794,007 | 401,838 | 22 |
| Net earnings | $1,398,554 | $1,210,296 | $188,257 | 16 |
| P.c. of ex. to gr. earn. | 61 | 60 | | |

The comparative statement of the Northern Central for the month of September and the nine months ending Sept. 30 is as follows:

| | 1888. | 1887. | Inc. or Dec. |
|---|---|---|---|
| *September:* | | | |
| Gross earnings | $566,205 | $452,632 | I. $113,573 |
| Oper. expenses | 388,080 | 390,846 | D. 2,766 |
| Net earnings | $178,125 | $61,786 | I. $117,339 |
| *Jan. 1 to Sept. 30:* | | | |
| Gross earnings | $4,628,897 | $4,697,189 | D. $68,282 |
| Oper. expenses | 3,142,576 | 2,954,084 | I. 198,492 |
| Net earnings | $1,486,321 | $1,725,105 | D. $238,784 |

Earnings of railroad lines for various periods are reported as follows:

| | 1888. | 1887. | Inc. or Dec. | P.c. |
|---|---|---|---|---|
| *Month of September:* | | | | |
| Balt. & Potomac | $133,976 | $129,034 | I. $4,942 | 3.8 |
| Net | 55,019 | 63,934 | D. 8,915 | 13.9 |
| Camden & Atl. & br. | 75,446 | 62,504 | I. 12,942 | 20.7 |
| Net | 15,105 | 9,255 | I. 5,850 | 62.9 |
| Det., Bay C. & Alp. | 33,347 | 43,509 | D. 10,162 | 23.3 |
| Net | 11,097 | 17,528 | D. 6,431 | 36.7 |
| Duluth, S. S. & Atl. | 283,388 | 191,808 | D. 8,420 | 4.4 |
| Net | 63,059 | 104,836 | D. 41,777 | 40.0 |
| Lehigh & Wilkes C. | 979,806 | 832,740 | I. 147,066 | 17.6 |
| Net | 213,084 | 170,081 | I. 43,003 | 25.2 |
| Northern Central | 566,205 | 452,632 | I. 113,573 | 25.1 |
| Net | 178,125 | 61,786 | I. 116,339 | 188.1 |
| Phila. & Reading | 1,932,783 | 1,968,612 | D. 35,819 | 1.8 |
| Net | 975,221 | 1,055,624 | D. 80,403 | 7.6 |
| P. & R. C. & I. Co. | 2,025,682 | 2,135,081 | D. 109,399 | 5.1 |
| Net | def. 40,520 | 207,311 | D. 247,831 | .... |
| Total both co.'s | 3,958,465 | 4,103,693 | D. 45,238 | 1.1 |
| Net | 934,702 | 1,262,935 | D. 228,233 | 18.1 |
| Tenn. C., I. & R. R. Co.: | | | | |
| Net | 48,500 | 32,700 | I. 15,800 | 48.3 |
| Wash., Ohio & W. | 14,381 | 15,038 | D. 657 | 4.4 |
| Net | 6,672 | 7,115 | D. 443 | 6.2 |
| West Jersey & br. | 140,856 | 135,608 | I. 5,248 | 3.9 |
| Net | 38,880 | 50,025 | D. 11,145 | 22.3 |
| *Month of August:* | | | | |
| Atch., Top. & S. F. | 1,318,744 | 1,501,376 | D. 182,632 | 12.2 |
| Net | 448,333 | 688,279 | D. 239,746 | 34.9 |
| California Southern. | 109,999 | 116,684 | D. 6,685 | 5.7 |
| Net | 4,308 | 45,959 | D. 41,651 | 90.5 |
| Denver & Rio Grande | 705,700 | 734,035 | D. 28,335 | 38.1 |
| Net | 248,927 | 312,294 | D. 63,367 | 20.3 |
| East Tenn., Va. & G. | 470,874 | 441,798 | I. 29,076 | 6.6 |
| Net | 142,345 | 121,383 | I. 20,962 | 17.2 |
| Knoxville & Ohio | 39,916 | 42,123 | D. 2,207 | 5.2 |
| Net | 12,454 | def. 2,545 | I. 14,999 | ... |
| New Brunswick | 78,858 | 74,000 | I. 4,858 | 6.6 |
| Net | 23,090 | 27,158 | D. 4,068 | 15.2 |
| *Nine Months—Jan. 1 to Sept. 30:* | | | | |
| Balt. & Potomac | 1,140,500 | 1,063,906 | I. 76,594 | 7.2 |
| Net | 382,286 | 395,598 | D. 13,312 | 3.3 |
| Camden, Atl. & brs. | 582,688 | 572,782 | I. 9,906 | 1.7 |
| Net | 138,401 | 155,932 | D. 17,531 | 11.2 |
| Det., Bay C. & Alp. | 356,634 | 366,372 | D. 9,738 | 2.7 |
| Net | 132,447 | 167,764 | D. 35,317 | 21.0 |
| Duluth, S. S. & Atl. | 1,074,981 | 1,080,516 | D. 5,535 | 0.5 |
| Net | ..... | ..... | ..... | ... |
| Lehigh & Wilkes Co. | 7,527,017 | 6,277,497 | I. 1,229,520 | 19.5 |
| Net | 1,470,017 | 882,773 | I. 587,334 | 66.5 |
| Natchez, Jack. & Col. | 103,313 | 116,339 | D. 13,026 | 11.2 |
| Net | 16,695 | 19,765 | D. 3,160 | 16.0 |
| Northern Central | 4,628,897 | 4,679,189 | D. 50,292 | 1.8 |
| Net | 1,486,321 | 1,725,105 | D. 238,784 | 13.8 |
| Phila. & Reading | 15,034,975 | 16,065,531 | D. 1,968,556 | 12.3 |
| Net | 6,883,809 | 8,305,552 | D. 1,421,743 | 17.1 |
| P. & R. C. & I. Co. | 13,426,805 | 13,539,282 | D. 1,124,770 | 8.4 |
| Net | 107,625 | 863,493 | D. 755,868 | 87.5 |
| Total both co.'s | 28,461,780 | 29,542,813 | D. 1,081,033 | 3.7 |
| Net | 6,991,435 | 9,169,045 | D. 2,177,610 | 23.7 |
| Tenn. Coal & Iron C. | ..... | ..... | ..... | ... |
| Net | 502,300 | 427,302 | I. 74,998 | 17.5 |
| Wash., Ohio & West. | 89,695 | 88,365 | I. 1,330 | 1.5 |
| Net | 22,049 | 28,342 | D. 6,293 | 22.2 |
| West Jersey & brs. | 1,241,767 | 1,167,152 | I. 74,615 | 6.4 |
| Net | 461,239 | 455,743 | I. 5,496 | 1.2 |
| *Eight Months—Jan. 1 to Aug. 31:* | | | | |
| Atchison, T. & S. F. | 9,827,142 | 12,127,912 | D. 2,300,770 | 19.0 |
| Net | 2,917,059 | 5,561,141 | D. 2,644,082 | 47.5 |
| California Southern. | 1,132,600 | 956,455 | I. 176,145 | 18.4 |
| Net | 258,426 | 422,331 | D. 163,905 | 38.8 |
| Denver & Rio Grande | 4,932,391 | 4,967,741 | D. 353,500 | 7.2 |
| Net | 1,529,137 | 2,010,269 | D. 481,132 | 23.9 |
| East. Tenn., Va. & G. | 3,583,062 | 3,250,868 | I. 332,194 | 10.2 |
| Net | 1,209,772 | 838,826 | I. 370,946 | 44.2 |
| Knoxville & Ohio | 317,123 | 292,378 | I. 24,745 | 8.4 |
| Net | 131,582 | 88,122 | I. 43,460 | 49.3 |
| Mo., Kansas & Tex. | 3,990,001 | ..... | ..... | .... |
| Net | 795,959 | ..... | ..... | .... |

Early reports of monthly earnings are usually estimated in part, and are subject to correction by later statements.

## ANNUAL REPORTS.

The following is an index to the annual reports of railroad companies which have been reviewed in previous numbers of the current volume of the *Railroad Gazette:*